HOUSEHOLD MECHANICS

BEDELL AND GARDNER

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Preface

THIS revised edition of HOUSEHOLD MECHANICS FOR THE GENERAL SHOP gives more information about household appliances, a larger selection of jobs, and retains the best features of the first edition. The pupils become acquainted with the Industrial Arts through jobs that interest them because of their natural desire to participate in home maintenance problems. The material is arranged in such a manner that the student is placed on his own initiative as much as possible. By this method the instructor finds that individualized teaching and learning are facilitated.

The jobs and problems presented hold the interest of girls as well as boys. Women charged with the responsibility of a home will find the jobs to be the ones met in the daily routine.

Every job and every lesson has been selected from the note books of experienced teachers. Letters from fathers and mothers to teachers testify to the strong appeal that the presentation has to pupils. This is particularly true because this book shows just how to care for and to repair such items as water faucets, electric sockets and hardware that are in actual use in the home.

The life of a house frequently is estimated at fifty years. Practically all of us live in houses that are several years old. The equipment installed now in our homes represents a long period of development in design. The selection of this equipment and its maintenance are matters of pride and vital interest to us. The importance of keeping it in good repair and of intelligently using the various household appliances and mechanical equipment in our homes has been recognized during the war emergency.

The broader objectives of an Industrial Arts program are readily given emphasis in a general shop organized to teach Household Mechanics because:—

There is a variety of materials and tools;
It encourages worthy home membership;
It provides opportunity for initiative;
Practice in citizenship is continuous;
Individualized instruction predominates.

Preceding each job in this book the essential information for doing the job will be found. The step by step procedures guide the pupils in developing good habits of work, and at the same time there is a skilfully arranged set of questions and self-appraisal guides which insure a maximum amount of pupil problem solving.

Although the book is written primarily in the language of the junior high school pupil, it is a satisfactory source of information for the adult. The adult appeal has been further confirmed by the increase in the number of home workshops, and the chapter on the home workshop was added especially to assist the hobbyist in setting up a workshop at home. In fact, the book will be found valuable as a reference and study guide for men and women in solving many problems in home making.

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JOBS

Woodworking

Chapter 1

WOOD is probably more widely used for construction and repair purposes than any other material. For this reason everyone should know how to use it, what it is used for and how to care for things made of it. This unit of study is intended to give the information which will be most valuable to everyone.

There Are Many Things About Wood That the Worker Should Know Before He Starts to Work With It. Here Is a Brief Summary of the More Important Things.

The forests of the whole world are the source of supply for lumber. The United States furnishes large quantities of both hard and soft wood. Pine, spruce, and fir grow in the higher altitudes, while many kinds of hardwood grow in most every state in the union. There are, however, many fancy woods imported from tropical countries for people who desire unusual grains and colors in their furniture and woodwork.

Wood is generally divided into two classes, namely: hard and soft. The soft woods include those which come from the cone bearing or evergreen trees, such as pine and fir. All others are classed as hardwoods. It may be difficult to understand why this classification is made, as some of the so-called hard woods are really softer than some of the soft woods. It is merely a handy classification. Any other plan would necessitate the rating of each kind of wood according to its hardness or softness in relation to all the other kinds. This would be confusing and not altogether accurate, as there is a wide variation in the same kind of wood.

When trees are cut for lumber, only the main part, or trunk, is used. The branches are not usually large enough to provide much lumber, except in the case of some of the hardwoods. When looking at the end of a log, numerous rings can be seen. They start at the center, and each outer ring is a little larger than the previous inner one. These rings are called growth rings and tell the age of a tree. Each year a tree lives, it gets a new ring, just inside the bark.

Grain

The variation in color of these growth rings shows cross sections of the harder and softer fibers of the wood. In other words, it shows the grain. When the wood is cut lengthwise, the grain appears in an entirely different pattern, which is determined by the kind of wood, the way it is sawed, and the things which have happened to the tree during its lifetime. A limb which has grown out from the trunk will produce a decided change in the grain at that point. The term "grain" is used when speaking of the direction of the fibers in the wood.

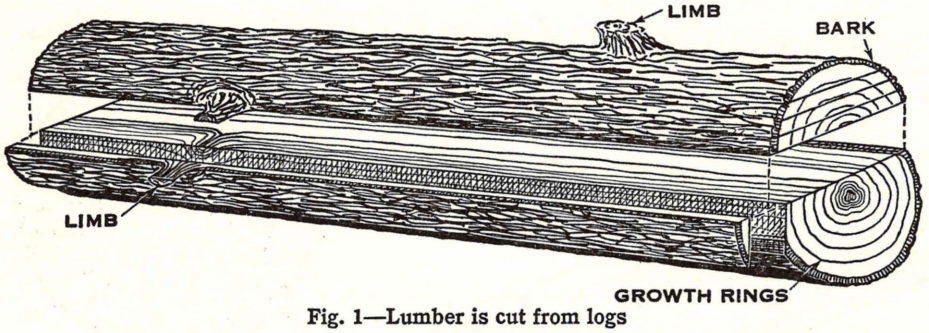


Fig. 1—Lumber is cut from logs

Flat-Sawed and Quarter-Sawed Lumber

Most lumber is sawed so that the surface of the boards is almost parallel with the annual growth rings. The grain of the wood shows very plainly on the surface. This method of sawing is called *flat sawing*. This is the most economical method of sawing logs into lumber

When lumber is quarter-sawed, the growth rings are, as nearly as possible, at right angles to the surface of the wood. Oak is commonly quarter-sawed

because of the beauty of the grain. The edges of the growth rings produce a very pleasing effect. Any wood which is quarter-sawed warps and shrinks much less than flat-sawed lumber. Woods other than oak, when quarter-sawed, are sometimes called *edge-grain* lumber. Wood for shingles and flooring should be edge grain lumber so that they will not warp. Edge-grain maple also makes a better bench top than flat-sawed maple.

Standard Sizes and Specifications

"LENGTH," when used in reference to lumber, means the direction in which the grain runs, also the direction in which the wood splits most easily. Therefore, a board may be wider than it is long.

"WIDTH" is the direction across the grain, on the broadest surface of the wood.

"THICKNESS" is the distance between the two broad surfaces. (See Fig. 4.)

In stating the size of lumber, the thickness is always given first, then the width, and last the length. Thus, a board 1″×12″×10′ would be 1″ thick, 12″ wide, and 10 ft. long.

Lumber is sawed into many sizes, according to the purpose for which it is intended. The ordinary person is concerned mostly with *rough-sawed*, and *surfaced* lumber. Rough-sawed lumber is left rough, just as it comes from the sawmill. Surfaced lumber has been put through a planing machine, making is smooth on one or both sides.

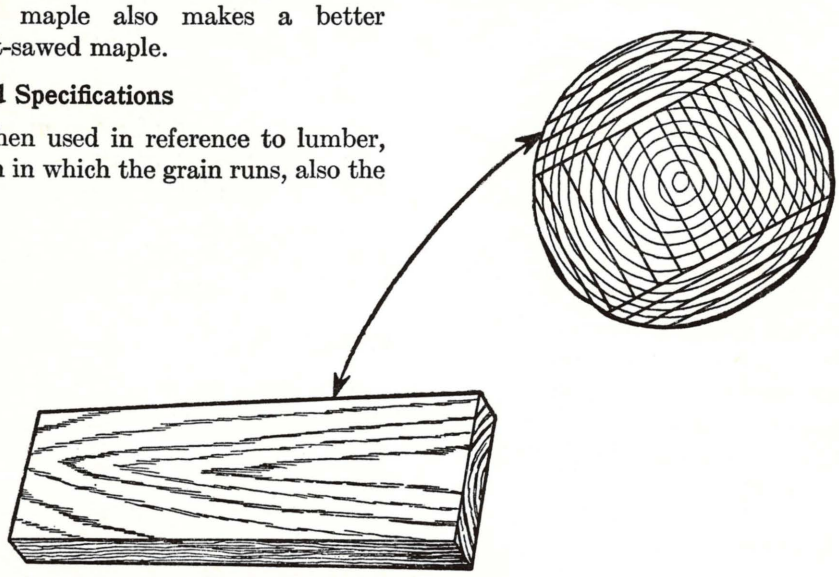


Fig. 2—The grain of the wood shows plainly on the surface of flat-sawed lumber

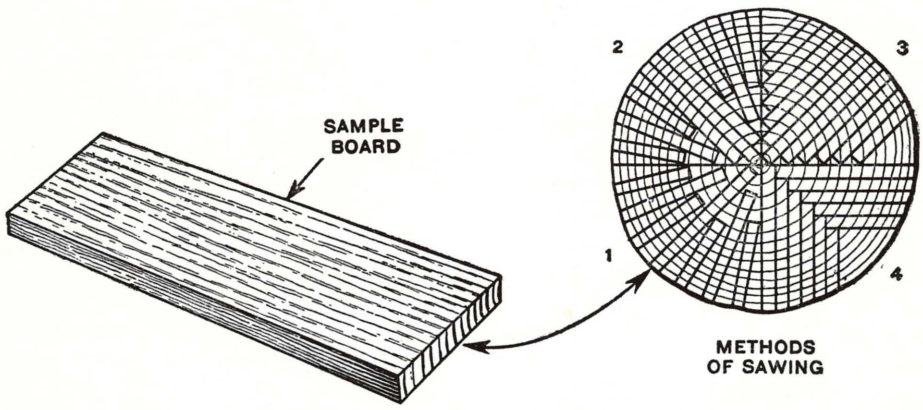


Fig. 3—In edge-grain or quarter-sawed lumber, the growth rings are at right angles to the surface

The household mechanic will discover, when buying lumber, that one inch surfaced lumber is not one inch thick. It is only about $\frac{13}{16}$″ thick. This is because the lumber company charges for the thickness of the lumber before it was planed. Surfaced lumber which is a full inch thick is made from $1\frac{1}{4}$″ stock, and is called "five-quarter" or $\frac{5}{4}$, lumber.

Most lumber is sold already surfaced for a number of reasons. Surfaced lumber is easier to handle

because it is smooth, and does not have many slivers. If the carpenter had to surface his own lumber on the job, it would take him much longer to build a house. The lumber mill can do as much in a few minutes, as a carpenter could do in a day. Also, the lumber mill uses the shavings for making other building products. Shavings made by the carpenter on the job usually have to be burned as waste.

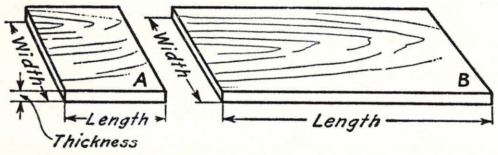


Fig. 4—The length of a board is measured in the same direction as the grain

Heavy pieces of lumber are usually called timbers. These include pieces used for the joist, sills, studding, and rafters in houses. Planks are pieces from 2″ to 3″ in thickness, and at least 6″ wide. It is not safe, however, to draw any definite line of classification between boards, timbers, and planks.

Lumber is rough sawed into standard lengths and widths. The standard lengths are 8′, 10′, 12′, 14′, 16′, and 18′. The standard widths are 2″, 4″, 6″, 8″, 10″, and 12″. Other lengths and widths can be obtained, especially in planks or thin boards.

Figuring Lumber

Lumber is measured and sold by a unit of measure known as the board foot which is the equal of a piece 1″ thick×12″ wide×12″ long. There is a general rule to follow in finding the number of board feet in a piece of lumber. Multiply the length in feet by the width and thickness in inches, and divide by 12. Thus, a board 1″×6″×12 ft. contains 6 board feet of lumber. A plank 2″×6″×12 ft. contains 12 board feet of lumber.

Example: $\frac{1''\times 6''\times 12'}{12'}$ equals 6 board feet

The Seasoning of Lumber

When lumber is cut from a log it contains moisture, and is not ready for use until the moisture has been taken out. A common way of removing this moisture is to pile the boards so that the air will circulate through the pile until they are dry. The product is called air-dried lumber. Lumber may be made still drier by putting it into a steam heated room called a kiln. Care must be taken that the boards dry evenly on both sides in order to prevent warping. If a board dries more in some spots than others, it is likely to twist or "wind." Lumber for inside finish in houses, and for furniture should be kiln dried.

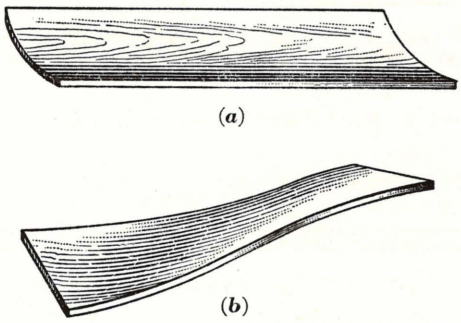


Fig. 5—The "warp" and "wind" in boards is caused by uneven drying. (*a*) A warped board. (*b*) Wind in a board (exaggerated)

Some woods have more of a tendency to wrap or wind than others. Houses which are made of new or poorly seasoned lumber are often drawn out of shape when the wood dries. For this reason, many carpenters like to get timbers from an old house when building a new one. But even well seasoned lumber may warp if left unpainted. Always paint woodwork which is exposed to the weather.

If You Have Read the Above Information Carefully You Should Begin to Have a Knowledge of Wood. See How Much You Have Learned by Answering These Questions.

1. The term _____ is used when speaking of the direction of the fibers in wood.
2. In lumber _____ has reference to the direction in which the wood splits most easily.
3. In stating the size of lumber, the _____ is always given first.
4. White pine is classed as a _____ wood, and oak as a _____ wood.
5. In stating the size of lumber, the symbol (″) means _____ and the symbol (′) means _____.
6. In a piece of lumber 2″×4″×16′, there are _____ board feet of lumber.
7. In a piece of lumber 1″×6″×12″, the thickness is _____, the width is _____, and the length is _____.
8. A board may _____ if it dries faster on one side than on the other.
9. The rings which can be seen on the end of a log indicate the _____ of the tree from which it was cut.
10. When a board becomes twisted in the process of seasoning or drying, the twist is called _____.

11. Oak lumber is sawed by a method known as _____ to produce a beautiful grain.
12. Wood other than oak, when quarter-sawed, is known as _____ _____ lumber.
13. Wood sold as 1″ finished lumber, is really only about _____ thick.
14. Does the United States furnish hardwood, or softwood, or both?
15. What is meant by the seasoning of lumber?

FASTENING DEVICES FOR WOOD

A knowledge of how to fasten two pieces of wood together, or of how to fasten hardware to wood is very necessary for the home woodworker. Nails, corrugated fasteners, and screws are the more common fastening devices.

NAILS AND NAILING

Nails, or "wire nails," are made of soft steel wire. They are made in many shapes and sizes to suit the many different needs. The home woodworker need be concerned with only the more common. The size of nails is stated by the sign "d," and read

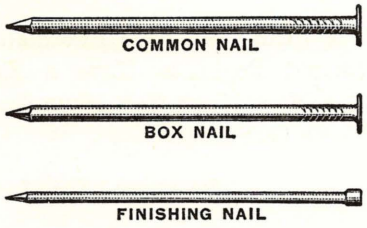


Fig. 6—The box and finishing nails are more slender than the common nail

"penny." For example, a 10d common nail is 3 inches long. The length of small nails or brads, is usually stated in inches. Common nails have standard diameters, but small nails and brads can be purchased in many diameters. Nails are sold by the pound.

The *common nail* is an "all purpose" nail. It is used on rough or outside work where strength is important. Its large diameter and large flat head give it excellent holding qualities. It is not used on inside or finish work, because the head cannot be "set" below the surface of the wood.

The *box nail* is very similar to the common nail, except that it is more slender. Like the common nail, it has a large flat head, therefore should not be used on finish work. It is used, as the name suggests, in making boxes of thin wood, where the heavier common nail would cause the wood to split.

The *finishing nail*, or *wire brad*, has a much smaller head than the common or box nail. The finishing nail should be used on all finish woodwork where the head is "set" below the surface of the wood. It can be purchased in various lengths from $\frac{3}{16}$ to 3 inches. Standard wire gage numbers are used for the diameters. It should be remembered that the larger the gage number, the smaller the diameter of the nail. There seems to be no set rule as to the difference between a brad and a finishing nail, but finishing nails smaller than $1\frac{3}{4}$ inches in length, are usually called brads.

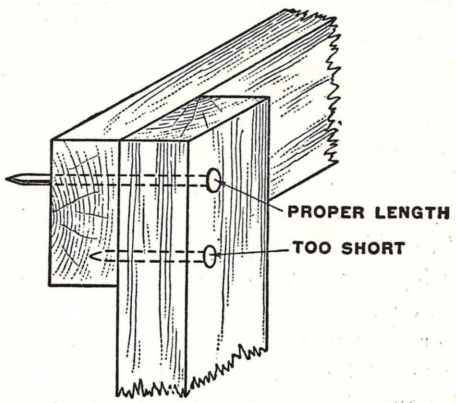


Fig. 7—The length of the nail should be about three times the thickness of the piece being nailed

Flat head nails in sizes similar to wire brads can also be purchased. As in case of the brad, there seems to be no set rule as to the difference between the box nail and the small flat head nail. They are especially useful in bird-house construction, and in other jobs requiring thin wood, but where the head of the nail does not have to be "set" below the surface of the wood. The large flat head is not as apt to pull through the wood as the small head of the brad, therefore it holds better.

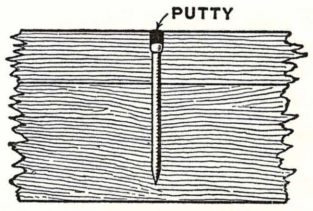


Fig. 8—Nail holes can be filled with putty

Selecting the Nail

In selecting the kind of nail to use on any job, there are several things to consider.

First, the length of the nail should be about three times the thickness of the piece of wood being nailed, whenever possible. In nailing two pieces

of the same thickness, enough of the nail is left extending through the wood for clinching. When nailed to a thick piece of wood, the point of a short nail does not have a chance to hold tightly enough.

Second, the diameter of the nail should be small enough that it does not split the wood. If it seems best to use a large nail in thin wood, a pilot hole should be drilled and the nail driven through it. The diameter of the hole should be smaller than that of the nail. This is often necessary when driving a nail into hardwood, and by applying soap to the point of the nail the job is made still easier.

Third, the appearance of the finished job is important. If strength alone is desired, a nail with a large flat head should be used. But if a finished appearance is desired, a nail with a small flat head should be selected so that it may be "set." If the hole over the head of the nail is filled with putty, it will be almost completely hidden when paint is applied. In stained work, the hole may be filled with stick shellac, plastic wood, or putty stained to match the color of the wood. (See Fig. 8.)

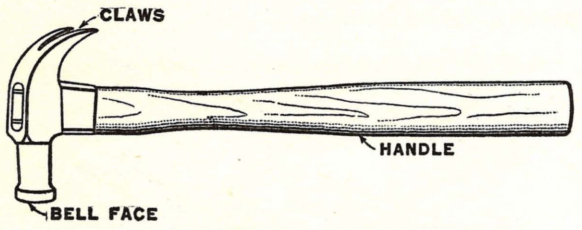


Fig. 9—The claw hammer

Points on Nailing

After the nail is selected for the job, it is necessary to determine where and how to drive it. A little forethought on this matter may save a great amount of trouble.

Tools

The claw hammer is designed especially for driving nails. The face is slightly rounded, called a "bell face," to prevent marring the wood when the head of a nail is driven down flush with the wood.

Nailing that is well done indicates the work of a good mechanic. Good nailing can be done with a good hammer, skilfully used. No craftsman ever misuses his hammer by striking stones or hard metal with it. He is careful not to loosen or strain the handle by using it as a crow-bar. He is careful not to drop it, thus damaging the claws. A hammer after all is a delicate instrument, carefully made and accurately balanced, and should be used accordingly.

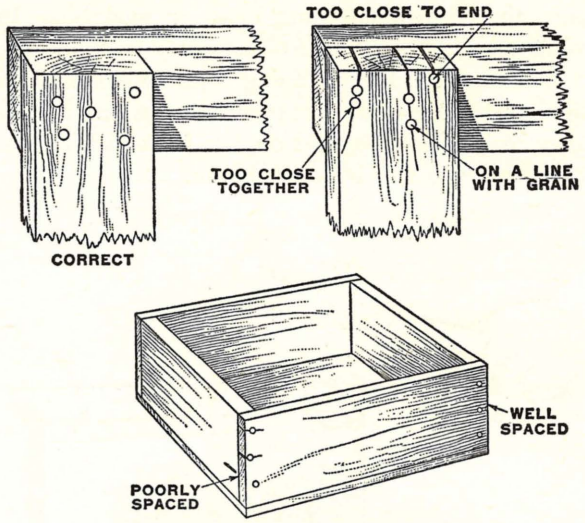


Fig. 10—The correct placing of nails is necessary for strong joints

Number and Position of Nails

A few nails, correctly placed, will produce a stronger joint than a larger number placed incorrectly. Nails should not be driven on a line along the grain of the wood. This is liable to cause the wood to split. Driving several nails close together, or close to the edge of the wood is also liable to cause the wood to split.

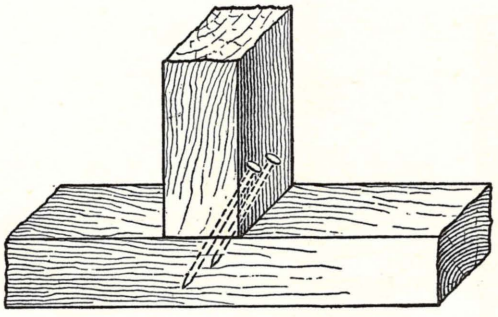


Fig. 11—Toe-nailing

Direction of Driving Nails

If nails are driven at an angle, they will give more strength than if they are driven straight. The size and shape of the wood will partly determine the angle. This will be noticed in "toe-nailing," as illustrated in Fig. 11. Sometimes, however, the nails must be driven straight. This is especially important where good appearance is necessary, and the head of the nail must be driven flush with the surface of the wood. (See Fig. 12.)

Support for Nailing

It is always easier to drive nails into a solid body, than into something loose or unstable. In nailing small articles, it is always easy to clamp the wood in a vise. But in doing repair work around the home this is not always possible. In that case, a heavy weight can be held on the back side of the wood while the nail is being driven.

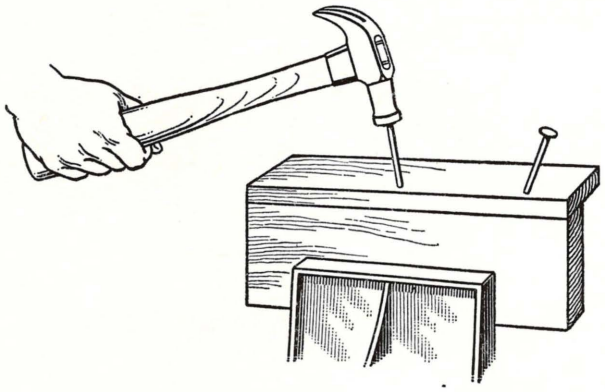


Fig. 12—Driving the nails at an angle will increase the strength of the joint

Preparation of the Wood

Be sure the pieces of wood fit together properly before they are nailed. Attempting to smooth rough ends after they are nailed, usually results in a very unfinished appearing job.

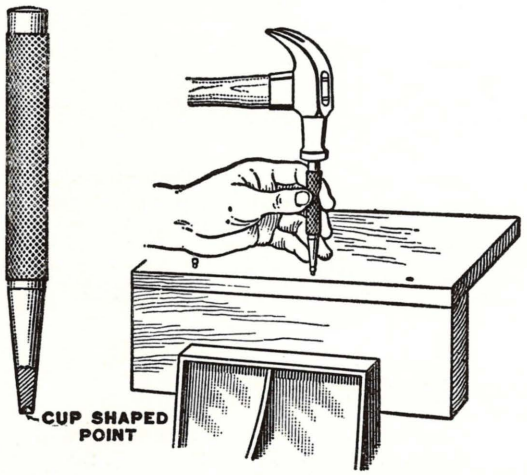


Fig. 13—The head of a nail is set below the surface of the wood with the aid of a nail set

Driving the Nail

When driving a nail, it is best to stand in such a position that the angle the nail is going can be seen. Hold the point of the nail at the proper angle, on the spot where it is to be driven. Grasp the end of the hammer handle with the other hand. Tap the nail lightly with the hammer to get the point started. If the nail does not start into the grain of the wood at the proper angle, remove the nail and try again. Never attempt to change the direction of a nail by bending it to one side with the hammer. It is better to remove the nail and make a new start.

In driving a nail, care should be taken to strike the nail squarely on the head. Missing the nail, or striking it a glancing blow, usually results in marring the surface of the wood or in bending the nail. Common nails should be driven all the way into the wood until the head is flush with the surface. Finishing nails should not be driven all the way into the wood with the hammer. An attempt to do this usually results in a marred surface.

Setting a Finishing Nail

The head of a finishing nail should be set below the surface of the wood with a nail set. Place the end of the nail set squarely on top of the head of the nail, and drive the nail into the wood with the hammer. (See Fig. 13.)

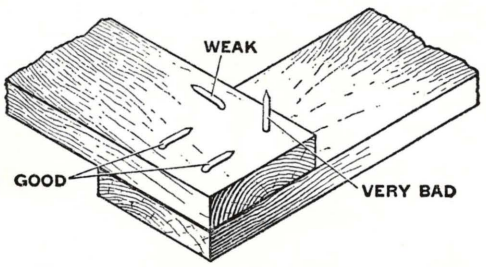


Fig. 14—Clinching nails across the grain makes the stronger joint

Clinching a Nail

When the nail extends through the second piece of wood, it is often desirable to clinch the nail, or bend it over. When possible, place the wood so that the head rests on a metal anvil. Sometimes a heavy hammer can be held against the head. Strike the nail directly on the point with the claw hammer. Clinching the nail with the grain gives a smooth job, but clinching across the grain gives a stronger joint.

Withdrawing a Nail

The claws on a hammer are for withdrawing, or "pulling" nails. Extreme caution should be used, however, or the handle may be broken. A block of wood should be placed under the head of the

hammer to give the necessary leverage. The longer the nail, the thicker the block should be.

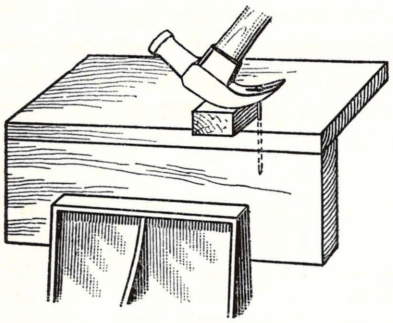


Fig. 15—A block should be used under the head of the hammer when pulling a nail

CORRUGATED FASTENERS

Corrugated fasteners are useful in fastening pieces of soft wood together, such as the pieces of a window screen, or a split in a table top. On account of their peculiar shape, it is not possible to use them successfully in hard wood. Corrugated fasteners are seldom used in fine cabinet work, but they are used by repairmen when better means of fastening are not available.

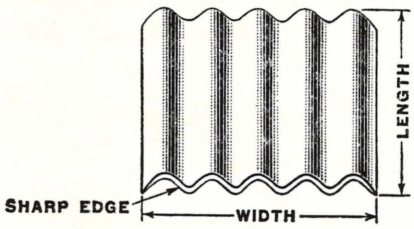


Fig. 16—The corrugated fastener

The length of the corrugated fastener should be about half the thickness of the board, otherwise the joint will be weakened. In the home workshop, various sizes should be on hand, perhaps, a box of assorted sizes.

The ordinary nail hammer should be used to drive the corrugated fastener. It must be driven with blows evenly distributed over the length of the fastener. It is also important that the soft wood into which the fastener is driven, is resting on a solid base. It may be used either with or against the grain of the wood.

SCREWS

A joint fastened with screws is much stronger than one fastened with nails. A screw joint, once assembled, may be taken apart without danger of splitting the wood. The screw may be tightened if once it becomes loose. However, care must be exercised not to strip the threads in the wood. More time and labor are required to install screws, but much better results are obtained.

Screws are made of soft steel or brass. Brass screws are used in places where steel screws are likely to rust. Screws are sold by the dozen, or by the gross.

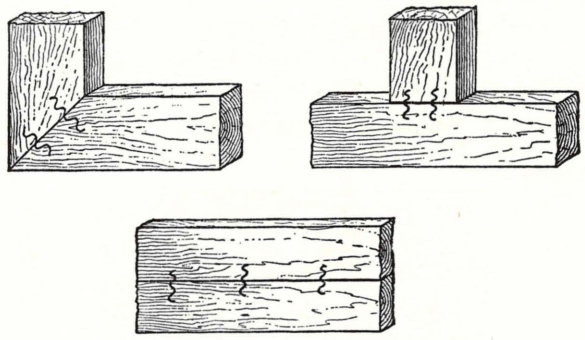


Fig. 17—Various uses of corrugated fasteners

The length of screws varies from $\frac{1}{2}''$ to 6″, and there are many different diameters for each length. The length is stated in inches, and the diameter in gage numbers. Unlike the nail, the smaller the gage number is, the smaller the diameter of the screw.

Kinds of Screws

The *flat head screw* is made so that the head of the screw sets even with, or slightly below the surface of the wood. The hole for the flat head screw is countersunk. The shape of the head makes it fit the countersunk hole. Flat head screws are made in natural bright steel, brass, blued steel, or japanned finish.

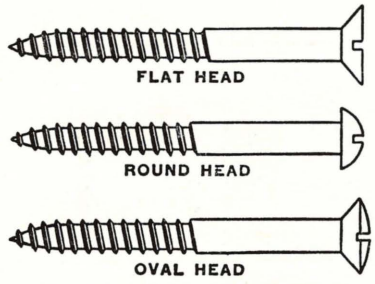


Fig. 18—Common types of screws

The *round head screw* is not used in a countersunk hole. The head extends above the surface of the wood. It is made in the same variety of finishes as the flat head screw.

The *oval head screw* is especially designed for fastening hardware to wood. The under side of the screw makes its use possible in a countersunk hole in metal, and the top of the head leaves no rough or sharp edges to catch and tear the clothing. This screw is made in the same finishes as the flat head screw.

It is as true with screws as it is with nails, that a few screws well placed will produce a stronger joint than a larger number poorly placed. The same rules apply for choosing the location.

There is no set rule for choosing the length of screws used in fastening one piece of wood to another, but in general, the length should be about twice the

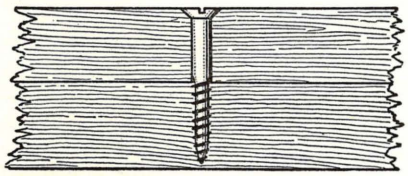


Fig. 19—The length of a screw should be about twice the thickness of the top piece of wood

thickness of the first, or top piece of wood. They should not, however, extend through the second piece of wood. When screwing into an end grain, the length of the screw may be even three times the thickness of the first piece.

Drilling the Shank Hole

In fastening two pieces of wood together, a hole should be drilled in both pieces. The hole in the first, or top piece, called the "shank hole," should be large enough that the shank of the screw fits the hole snugly, but loosely enough that it can be turned easily.

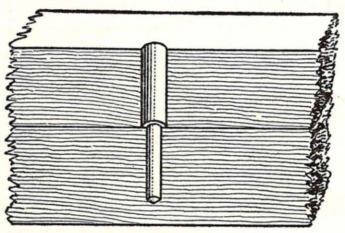


Fig. 20—Drilling the holes for a screw

Drilling the Anchor Hole

The hole in the second piece of stock is called the anchor hole, and should be smaller than the diameter of the shank of the screw. To be exact, the anchor hole should be the same diameter as the root diameter of the threads. This allows the threads of the screw to hold securely in the wood. The hole should be deep enough to accommodate the screw, but should not go all the way through the wood. (See Figs. 20 and 21.)

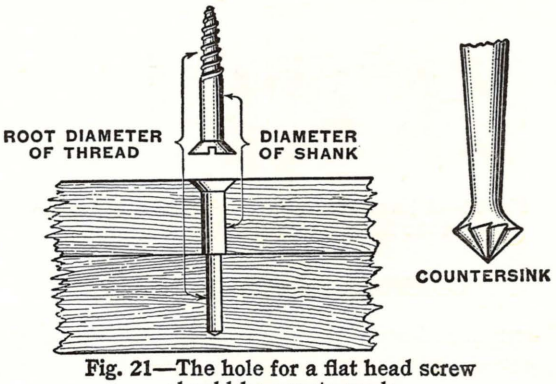


Fig. 21—The hole for a flat head screw should be countersunk

Countersinking Holes for Flat Head Screws

If a flat head screw is to be used, it is necessary to countersink the hole. The depth of the countersunk hole depends upon the size of the head of the screw. It should be deep enough to allow the head of the screw to set flush with, or below, the surface of the wood.

Fig. 22—A screw driven in a counterbored hole may be concealed by glueing a dowel in the hole

Counterboring

Sometimes it is desirable to counterbore the hole for the head of the screw. This is done to make it possible to plug the hole with a wood dowel or button, and conceal the head of the screw. This hole should be bored with an auger bit, the same diameter as the head of the screw, before the shank hole is drilled. After the screw is driven, a dowel or button may be cut from a piece of the same kind of wood and glued into the hole.

Driving the Screw

A screwdriver should be selected which fits snugly into the slot in the head of the screw. If the screwdriver does not fit the screw, it is likely to break

the head of the screw, or to slip and mar the surface of the wood.

Screws will often drive easier if soap is applied to the threads. Turn the screw until it seemes to set firmly. If it is turned too tightly there is danger of stripping the threads in the wood, or of twisting the screw off.

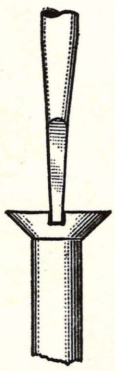


Fig. 23—The screwdriver should fit the head of the screw

Here are Some Test Questions on Fastening Devices

1. Which is larger, a 10d nail, or a 6d nail?
2. What kind of a nail should be used for finished woodwork in a house?
3. What is done to hide a nail hole after the nail has been set?
4. In which direction should a nail be clinched to make it hold best?
5. What should be done in drawing a nail to prevent breaking the hammer handle?
6. How are corrugated fasteners supposed to be driven?
7. Name three common kinds of screws.
8. How large should the shank hole be?
9. How large should the anchor hole be?
10. How long should a screw be?
11. Which ordinarily holds better, nails, or screws?
12. The heads of screws may be completely concealed by what process?
13. How large should a screwdriver be?
14. What kind of screw is commonly used for fastening hardware to furniture?
15. Is a No. 11 screw larger or smaller than a No. 7 screw?

PREPARING LUMBER FOR FINE WORK

Rough sawed lumber is not suitable for finished work. Even finished lumber has planer marks on the surface which have to be removed if the article to be made is to have a good finish. Therefore, one of the first things the household mechanic should learn to do is to prepare the surface of the lumber before starting to layout the design of the article to be made. Any warp or wind must be planed out.

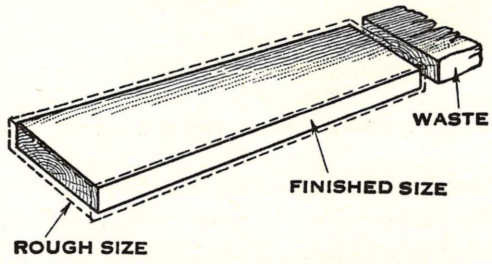


Fig. 24—The rough lumber must be larger than the finished piece desired

Saw marks, checks or splits in the end of the lumber, and other irregularities must be removed. The rough stock from which a finished piece is to be made must be a little thicker, wider, and longer than the finished piece desired.

JOB NO. 1

HOW TO PREPARE LUMBER FOR FINE WORK

It is not always necessary to plane all six surfaces of a piece of lumber. It is a waste of time to plane them all as long as one or two will be enough. Articles of irregular design often need only one surface planed. Sometimes both broad surfaces should be planed. At other times an edge or an end must be planed in order to make an accurate layout of the design. Therefore, in doing the following job, the household mechanic should do only those operations necessary before laying out the design of the project to be made.

The Equipment Necessary for this Job Is: a bench plane, a try square, a marking gauge, a rule, and a saw.

1. Plane the best broad surface smooth and true. The plane must be set to cut a fine shaving. Do not remove any more wood than is necessary to leave the surface smooth and true. Test carefully with a straight edge. Mark this surface No. 1. (See Fig. 25.)

If the project to be made is of irregular design, such as the Hot-Pad Holder, see Job No. 34, this may be the only operation necessary in preparing the

stock. However, it is usually a good plan to have both front and back surfaces smooth.

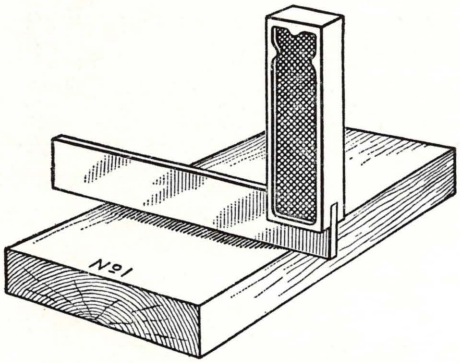


Fig. 25—Testing the face of a board

2. Plane the best edge of the board square and true with surface No. 1. Test with a try square and straight edge. Mark this edge No. 2. (See Fig. 26.)

If this edge is not square and true, it is impossible to use a try square accurately in laying out a design.

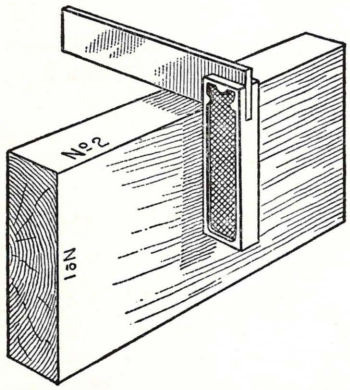
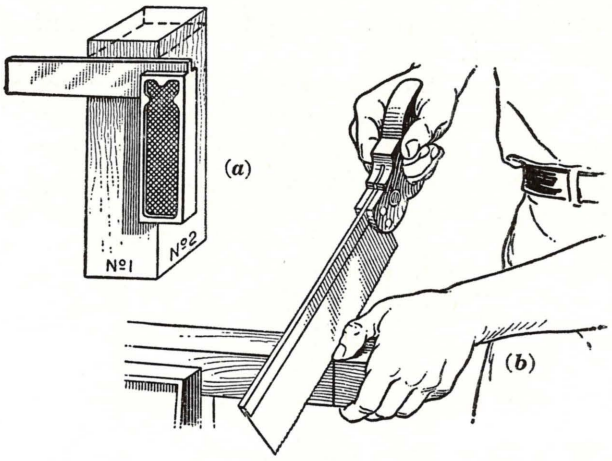


Fig. 26—Testing the edge of a board

3. Saw the best end square. Draw a line around the piece near one end to use as a guide in sawing. A try square must be used to make a squared line around the piece. Use a knife to make the lines. The lines must meet. Mark this end No. 3. (See Fig. 27.) If the end is already square, omit this step.

This is enough for the ordinary layout job. But in cases where the lumber must be finished to a certain size, as for a table top, follow the operations as described in sections 4, 5, 6 and 7.

4. Plane the end if necessary. If the end was not sawed accurately, or if the end is to be finished without further cutting, the end will need to be planed. It must be square. Set the plane to cut a fine shaving.



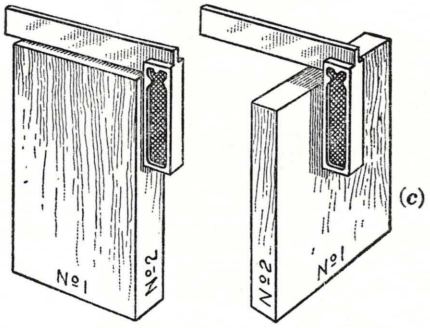


Fig. 27—Squaring an end. (*a*) Drawing the guide line. (*b*) Sawing with a back saw. (*c*) Testing for squareness

There are three methods of planing an end. Use the method which meets the situation best. (See Figures 27, 28 and 29.)

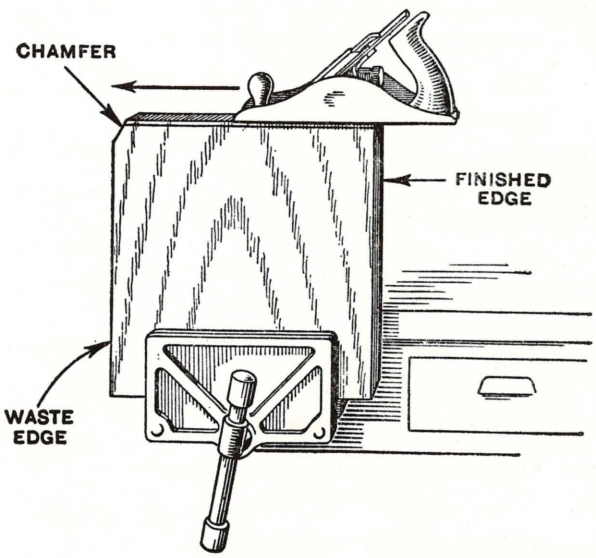


Fig. 28—Chamfer the waste edge and plane all the way across toward the chamfered edge, to avoid splitting the corners

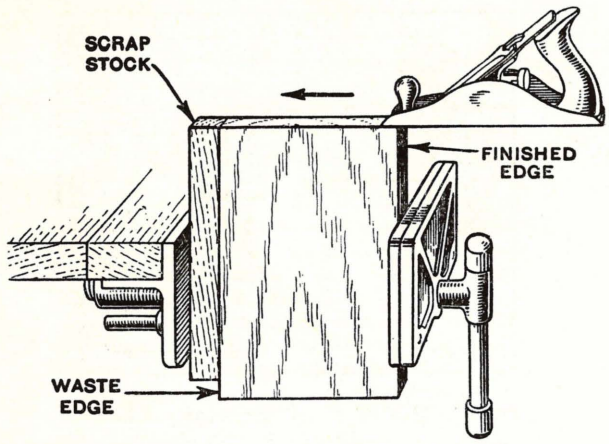


Fig. 29—When planing the end grain of a narrow piece of stock, clamp a piece of scrap stock against the waste edge, and plane all the way across toward the waste edge

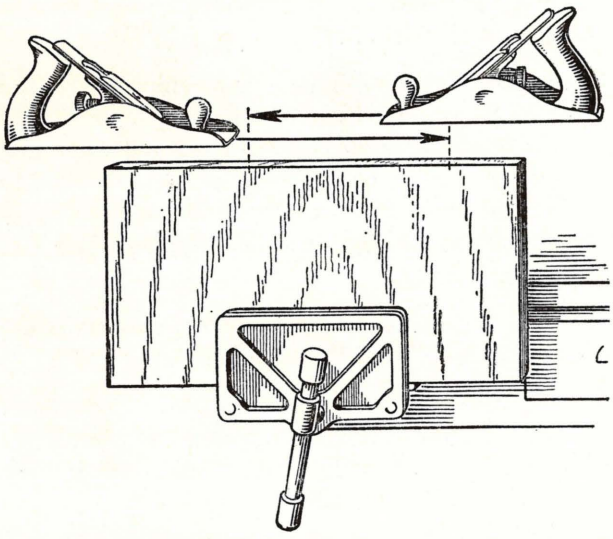


Fig. 30—When planing the end of a wide piece of stock, plane both ways past the center to avoid splitting of the corners

The three working surfaces should now be square, any way they might be tested with a try square.

5. Measure the length required and saw the other end square. If this end is to be planed, saw about $\frac{1}{16}$" on the waste side of the line in order that the stock will be the right size after the planing is done. Otherwise follow the same procedure as was used in sawing the first end square. (See Figs. 31 and 32.)

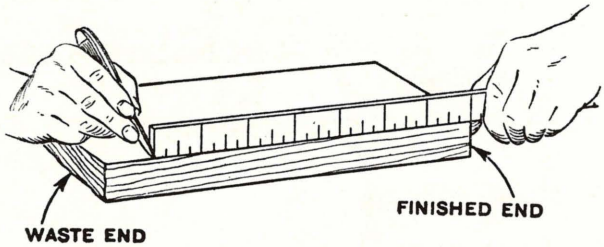


Fig. 31—Measure from finished end and mark with a knife

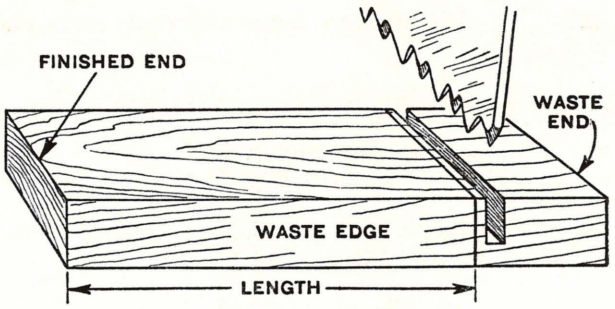


Fig. 32—Saw on the waste side of the line, toward the waste edge

6. Plane to width. Measure the width required from the finished edge. Then mark this width the full length of the stock with a marking gauge, on both broad surfaces. Plane the waste edge to the line, making sure to get the edge square before the line is reached. Do not plane past the line, or the stock will be too small.

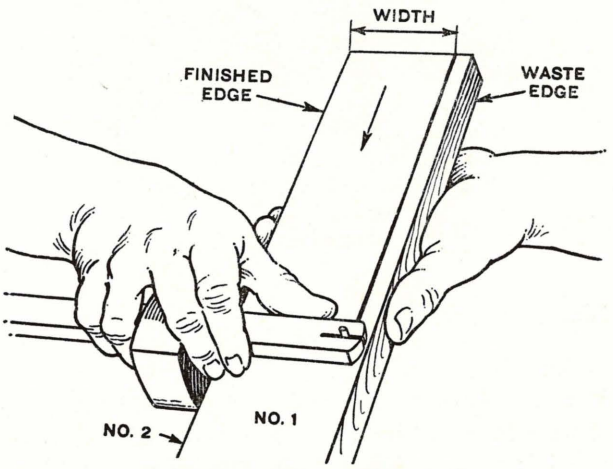


Fig. 33—Gauging the width

7. Plane to thickness. Measure from the finished broad surface and gauge with a marking gauge as for planing to width. Plane the unfinished broad surface down to the gauge line. Do not plane past the line or the stock will be too thin.

Job Test. Here are Some Questions to Test Your Knowledge of the Operations Just Performed.

1. Why does surfaced lumber need to be planed for fine work?

2. Why plane toward the waste edge when end planing?
3. What tool is used to gauge the width?
4. Can you imagine why a knife is used when marking the length?
5. Which method of end planing would you use for a narrow piece of stock?

JOB NO. 2

HOW TO MAKE A HOT-PAD HOLDER

Mothers often need a place to hang the pads which they use for lifting hot dishes. Here is a holder which looks very attractive if a little care is used in making it.

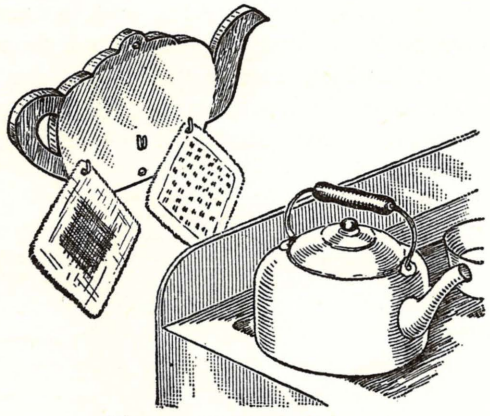


Fig. 34—The hot-pad holder

Materials Necessary:

One piece of wood, $\frac{3}{8}''\times5''\times9''$ and three screw hooks. The kind of wood used depends upon the kind of finish desired. If it is to be painted, basswood is good. If it is to be stained or varnished, pine or gumwood are suggested.

Equipment Necessary:

A coping saw, a bench plane, a pair of pliers, and a hand drill.

Here Is a Plan for Making a Hot-Pad Holder. Be Sure to Follow These Instructions Carefully.

1. Smooth the surface of the wood with the bench plane. Any warp or wind should be removed.
2. Lay out the design of the holder on the wood. The longer way of the design should be with the grain of the wood. In laying out this design, the wood should be marked off with a pencil in $\frac{1}{2}''$ squares. Then the design will be much more easily drawn.

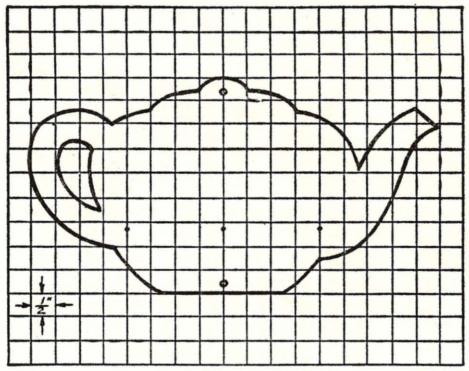
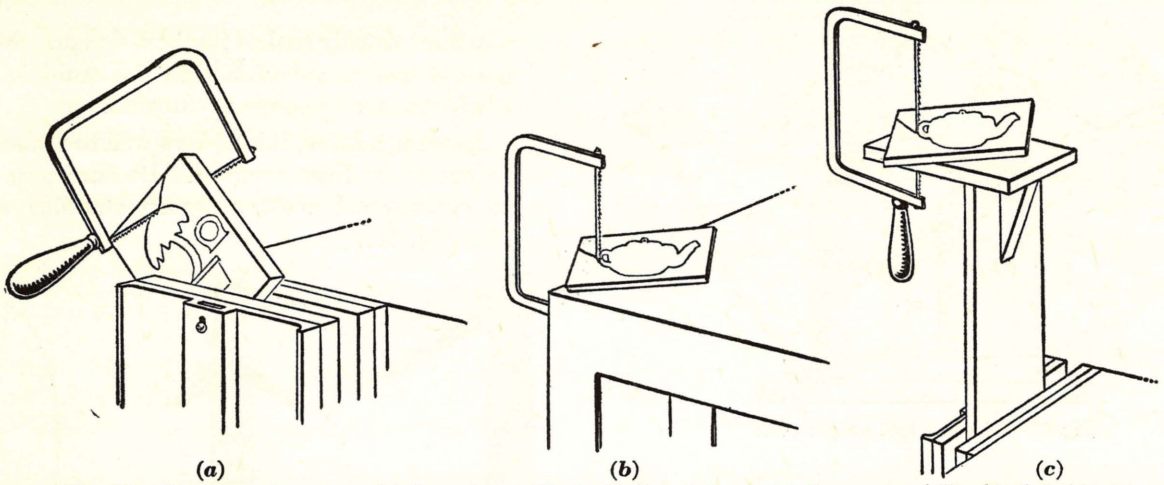


Fig. 35—Method of laying out the pad holder

3. Saw the board to shape with a coping saw. The wood may be held in a vise, flat on the top of the bench with the line to be sawed extending over the edge, or on a saw block. Be sure to hold the saw in a perpendicular position while sawing, so the edges will be straight. (See Fig. 36, *a*, *b*, and *c*.)
4. Drill the holes for attaching the holder to the wall. A $\frac{3}{16}''$ drill should be used.
5. Drill the holes for the screw hooks. These holes should be smaller than the shank of the screws used. A drill made from a small nail is very good for this purpose.
6. Smooth all rough edges. This may be done by using a fine grade of sandpaper such as No. 1. Sandpaper wrapped on a round stick works well on the curved edges.
7. The finish on the hot-pad holder may be of any type desired. A two-color paint job makes a fine appearance. Here is another plan which works very well.
   (*a*) Give the body a coat of shellac, and allow it to dry.
   (*b*) Stain the spout, lid and handle; then allow it to dry.
   (*c*) Sand the entire piece lightly with No. 00 sandpaper.
   (*d*) Wax the entire piece.
8. Attach the screw hooks. The pliers may be used to turn the screws into the wood.



(*a*) (*b*) (*c*)

Fig. 36—Using a coping saw. (*a*) In a vise. (*b*) On the bench top. (*c*) On a special Vee block holder.

Now That the Hot-Pad Holder Is Finished How Do You Like It? The following questions may help you to decide how well you have done the job.

1. Are there any scratches on the surface?
2. Are the edges even and square with the surface?
3. Is the finishing job well done?

The job is not really completed when the holder is made. In order to be of any use, the holder should be put up in the kitchen. Using two 1″ round head screws, attach it to the woodwork in the kitchen, near the stove. Pilot holes should be bored for the screws to make them drive easily. The holes should be smaller than the shank of the screws. (Fig. 34.)

Here are two other jobs which are suggested in addition to, or in place of, the hot-pad holder.

JOB NO. 3

THE PLANT HOLDER

This job should be cut out with the coping saw, and assembled with small nails. It should be painted a color that will blend with the color of the room in which it is to be used.

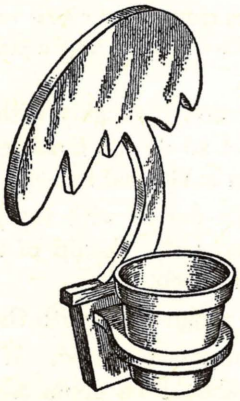


Fig. 37—The flower pot holder

JOB NO. 4

A SALT AND PEPPER RACK

Possibly mother does not need a hot-pad holder, but could use this salt and pepper rack to set on top of the stove. It could also be hung on the wall. A different design of your own choice could be used instead of the teapot.

JOB NO. 5

HOW TO MAKE A LETTER OPENER

Sometimes valuable mail is damaged in tearing letters open by hand. A letter opener carefully inserted will help in opening letters safely. Some very attractive ones can be made out of scraps of

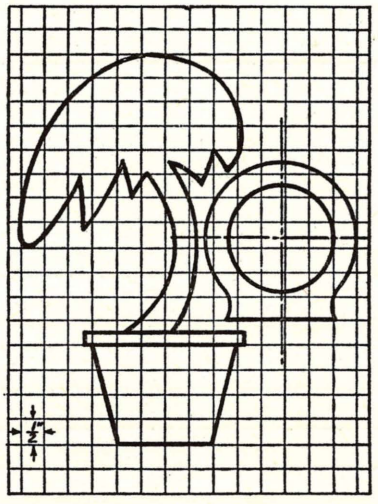


Fig. 38—Method of laying out the flower pot holder

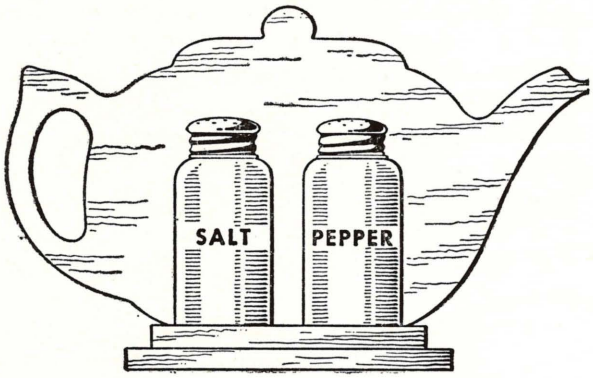


Fig. 39—The salt and pepper rack

wood with a jack knife. Care must be used in making anything that is worth while.

Materials Needed:

Materials which are ordinarily thrown away can be used for this job. However, a piece of wood with an attractive grain is suggested. Odd shaped pieces of a tree limb can be shaped into very attractive designs.

Equipment Needed:

An ordinary jack knife, and some small pieces of sandpaper are enough. A lead pencil will be found handy in laying out the design.

Here Are Some Suggestions for Making a Letter Opener Out of the Limb of a Tree. The design will depend on the shape of the limb to be used.

1. Select a tree limb which can be made into an attractive design. A limb from $\frac{3}{4}''$ to $1''$ in diameter usually makes the best design. Many good shapes may be found in the trunk of the Christmas tree when it is thrown away.

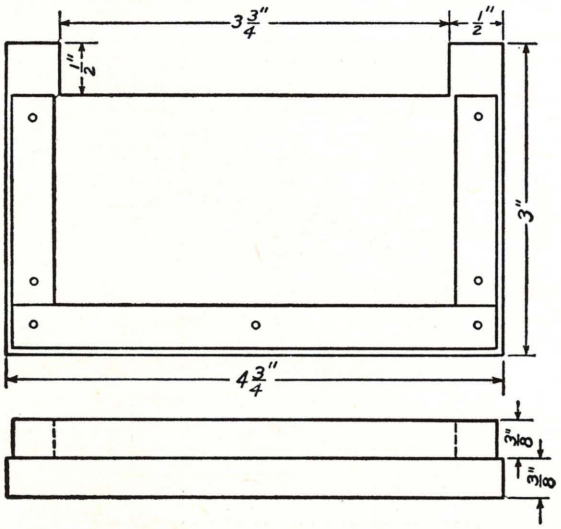


Fig. 40—Layout for the base of the salt-and-pepper rack. The design used for the hot-pad holder can be used for the back

In using a knife, it is always well to remember to cut away from yourself. Be sure also, not to cut toward another person standing near. (See Fig. 42.)

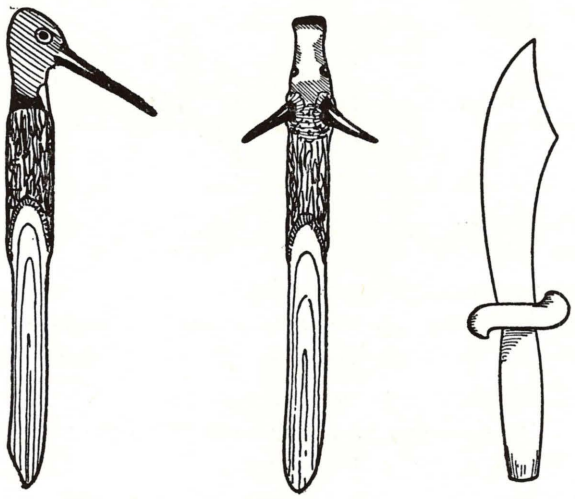


Fig. 41—Designs for letter openers

2. Decide on the design to be carved. Sometimes the bark is partly or entirely removed. Sometimes all of it is left on, giving a more rustic effect. (See Fig. 43.)

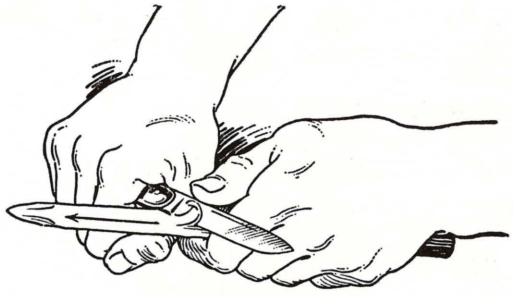


Fig. 42—Whittling with a jack knife

3. Cut out the design roughly with the jack knife. It is well not to do too much cutting until the entire design is blocked out.
4. Complete the design with the jack knife. Do not work too fast. A slip of the knife might spoil the whole job.
5. Smooth the rough parts with the sandpaper.
6. Decorate the letter opener. If it is to be left natural, it should be given a coat of shellac. If paint is desired, it may be applied over the

shellac. Where two colors of paint are used, the lighter color should be applied first.

7. When the paint is dry give the entire letter opener a coat of shellac, wax, or varnish.

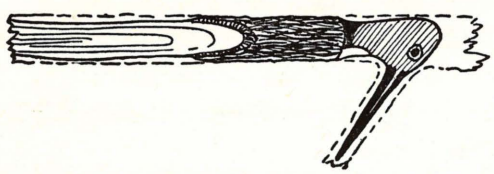


Fig. 43—Natural shapes in the branches may be used to make interesting designs

Does the Letter Opener Look Good Enough to be Put on the Writing Desk at Home? The following questions may help you decide.

1. Is it practical? Can it be used?
2. Is the opener well shaped? Is it artistic?
3. Are there any nicks or scratches in the finished parts?
4. In which direction should you cut when whittling with a jack knife?
5. Is a knife a wedge-edge, or a beveled-edge tool? Answer on page 208.

JOB NO. 6

HOW TO MAKE A KITCHEN REMINDER PAD

As mothers have a great deal to think about, it is not surprising that they forget things they need at the market, and have to send someone after them. A reminder pad that can be fastened to the wall in a handy place will be a great help. Things wanted can be written on the pad from day to day. Then, when shopping time comes, the list can be torn off the pad and taken to the market.

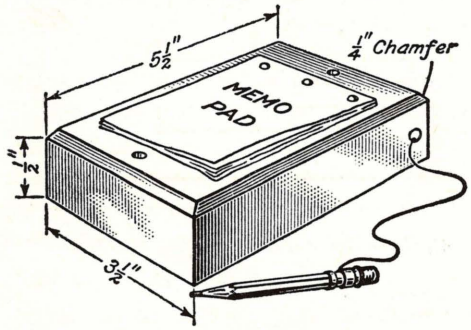


Fig. 44—The reminder pad

Necessary Materials:

When a piece of wood is to be squared to the proper size, it must always be larger to begin with than the size desired when finished. A certain amount of wood must be taken off the surfaces in order to get them smooth and true.

The wood used for this job must be squared and finished to $\frac{3}{4}''\times3\frac{1}{2}''\times5\frac{1}{2}''$. A piece should be selected which is about $1''\times4''\times6''$. This allows $\frac{1}{4}''$ on each edge and end, and $\frac{1}{8}''$ on each broad surface for squaring.

The kind of wood to be used for this job depends on the kind of finish desired. If it is to be painted, white pine or bass wood is suggested. If it is to be stained and varnished, some kind of wood with an attractive grain is suggested.

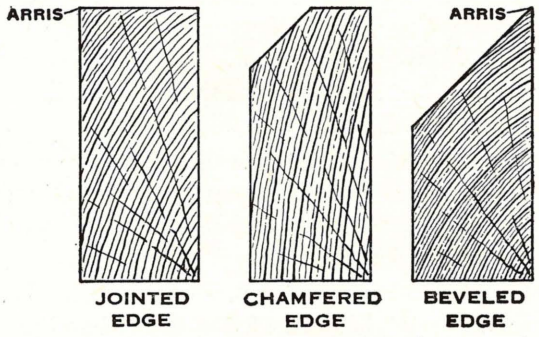
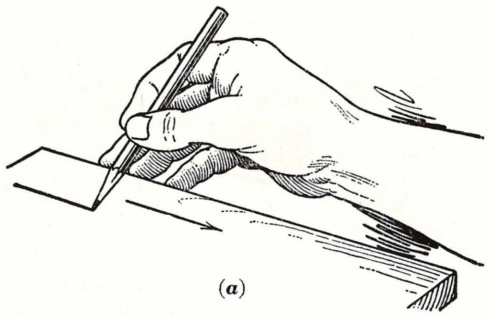


Fig. 45—A chamfered edge has the arris removed



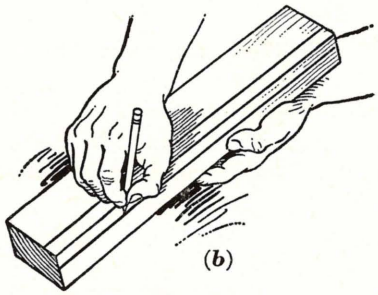


Fig. 46 (*a*) and (*b*)—Gauging with a pencil

Here Is a Plan for Doing the Job. Be sure to follow instructions carefully as there are several difficult things to do.

1. Square the stock to size, $\frac{3}{4}''\times3\frac{1}{2}''\times5\frac{1}{2}''$. Consult the directions for planing, pages 10 and 11.

2. Layout the chamfer. Chamfering is the process of removing the sharp arrises from a piece of wood. It differs from a bevel, in that only the arris is removed. An arris is a point on a piece of stock where two surfaces meet.

   Measure $\frac{1}{4}''$ from the arris with a rule, and mark with a sharp lead pencil. Then hold the pencil as for writing, and with the second finger against the edge of the wood, acting as a gauge, mark the gauge line the full length of the stock. The gauge may be held and marked on all sides of the face and the edges. (See Fig. 46.)

   The pencil gauge method is used here because the marking gauge leaves a mark in the wood which cannot be removed.

   Mark the lines $\frac{1}{4}''$ from the arris, on the surface, on both edges, and on both ends.
3. Plane chamfer. The ends should be planed first. Be sure to hold the plane at an angle. Planing straight across would split the wood at the corners. (See Fig. 47.)
4. Drill holes for fastening pad to the wall. These should be $\frac{1}{4}''$ holes, drilled with the hand drill.

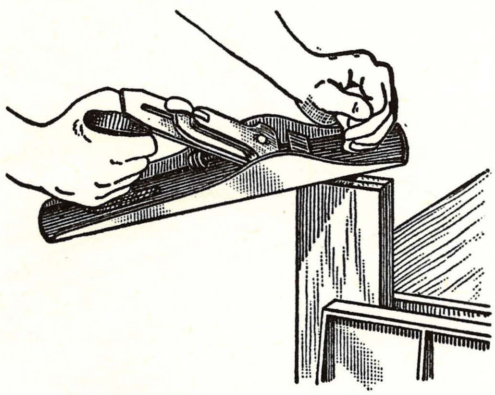


Fig. 47—Planing a chamfer

5. Sand all surfaces carefully. A medium sandpaper, such as No. 1 should be used. *Extreme care must be used in sanding, so as not to round the arrises.* A good way to prevent rounding the arrises is to place the sandpaper flat on the bench, and move the wood over it. In this way the wood can be held at the proper angle.
6. Paint or stain the wood as desired and allow it to dry. See painting, page 65.
7. Fasten a pad of paper on the block, with small nails. Nails about $\frac{3}{4}''$ long are the best size. They should not be so long that they go through the block.
8. Attach a string and pencil to the block. Having a pencil handy is the secret of the usefulness of the pad.

How Do You Like the Finished Job? Here are some questions to help you check it.

1. Test the block with the try square. Is it square?
2. Are the arrises of the chamfer sharp?
3. Has the pad of paper been put on neatly?
4. What is an arris?
5. Why not use a marking gauge to layout the chamfer?

The job is not really complete until the pad is put up in the kitchen, or some other place, where it is needed. Two round head screws, a drill, and a screw driver will be needed for this job.

JOB NO. 7

THE WINDOW STICK

Study carefully the illustrations showing the working plans for the window stick and the finished product before you attempt to make it.

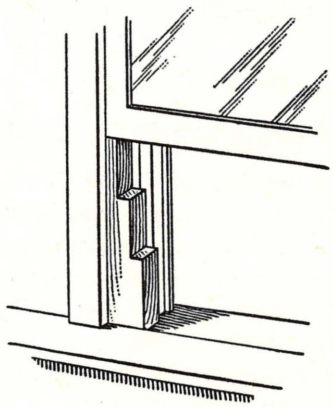


Fig. 48 (*a*)—The window stick

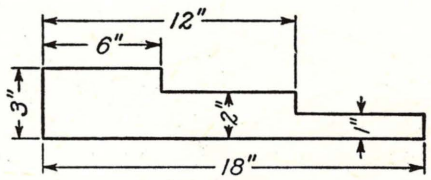


Fig. 48 (*b*)—The working drawing of a window stick

JOB NO. 8

HOW TO MAKE A CLOTHES STICK

In the laundry some kind of stick is needed to take the clothes out of the boiling hot suds. Any ordinary stick would serve, but here is one designed

for the purpose. It is easy to make and will be much appreciated.

Materials Needed:

A piece of white pine or bass wood squared to the dimensions, $\frac{3}{4}'' \times 2\frac{1}{2}'' \times 30''$. It can be thicker than $\frac{3}{4}''$ if desired. Allow extra wood for squaring.

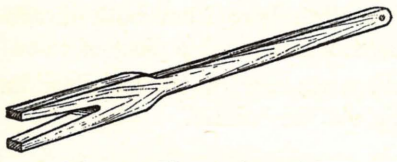


Fig. 49—The clothes stick

Equipment Needed:

The regular woodworking tools for squaring, a brace and $\frac{3}{8}''$ and $\frac{1}{2}''$ auger bits, a 1″ chisel, a spoke shave, and a pencil compass.

Here Is a Plan for Making the Clothes Stick.

Be sure to follow instructions carefully.

1. Square the stock to the desired size. Consult the directions at the beginning of this chapter for squaring. Use the dimensions as shown in Fig. 50.
2. Lay out the centerline on both broad surfaces from end to end. It is not a good plan to use the marking gauge, as it will put deep scratches in the wood.
3. Lay out the design of the clothes stick. Study the working drawing carefully before attempting this layout. Square lines across the piece at points A, B, C and D.
4. Bore the holes with the brace and the proper size auger bit. There is danger of splitting the wood around the hole when the bit is coming through the wood. To prevent this, as the feeding screw of the bit comes through, turn the piece around in the vise and bore from the other side. The holes on line C are there to make a smooth curve.
5. Saw the clothes stick to shape. It is a good plan to saw about $\frac{1}{8}''$ outside the line, and use a spoke shave and chisel to remove the wood remaining. Be careful not to cut the guide lines away. (See Figs. 52, 53 and 54.)
6. Shape the handle and the outside of the fork with a spoke shave and a wood chisel. The handle is not supposed to be rounded. Only the sharp edges should be removed.

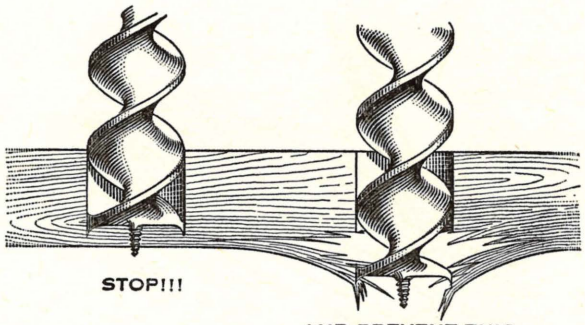


Fig. 51—Stop boring when the point appears. Turn the piece over and bore from the other side to prevent splintering

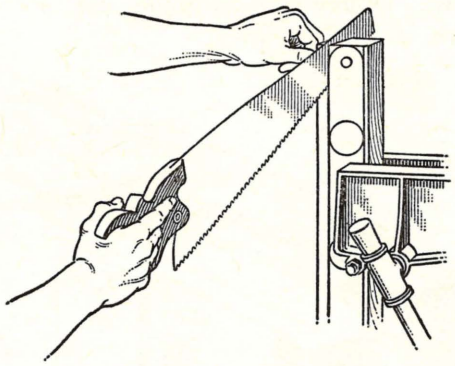


Fig. 52—Sawing out the handle

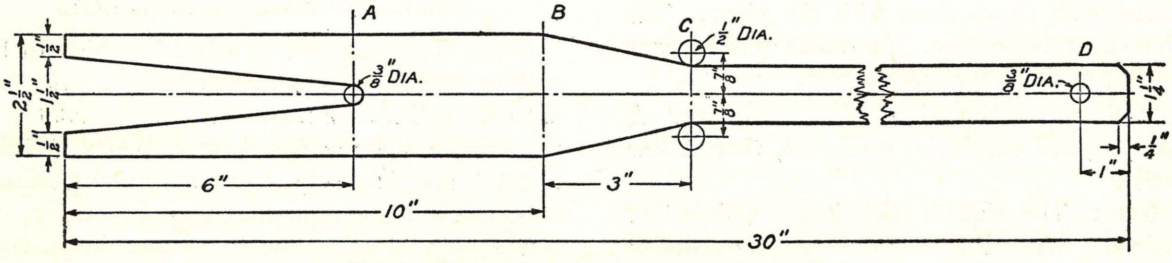


Fig. 50—The working drawing of a clothes stick

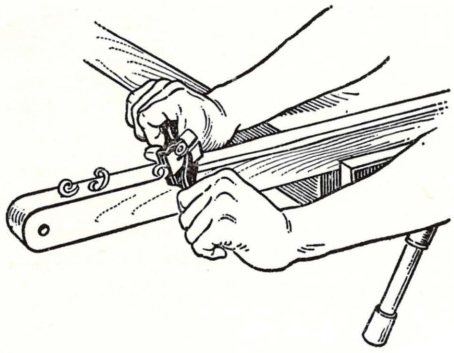


Fig. 53—The spoke shave may be either pushed or pulled

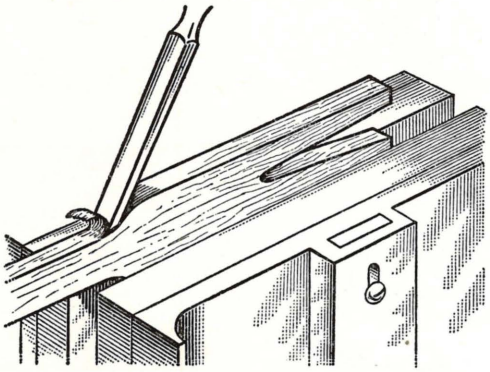


Fig. 54—Cleaning difficult places on the shoulders with a chisel

7. Shape the inside of the fork with a wood chisel. Notice that the flat side of the chisel is held down. Otherwise there would not be room to work.

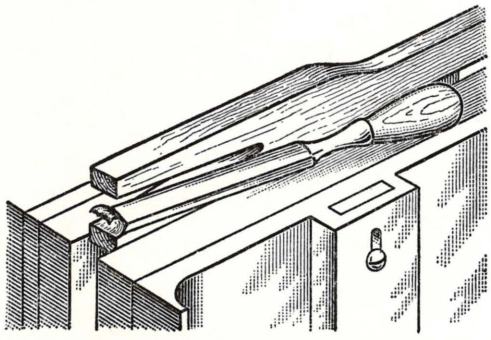


Fig. 55—Cleaning difficult places inside the forks with a chisel

8. Remove all pencil lines with the plane. The plane must be set fine. An eraser or sandpaper are not effective for this purpose.
9. Smooth the entire piece with sandpaper. A coarse grade should be used first, then a fine grade.

   Note: The clothes stick is not painted or stained. When it is used in water, the paint or stain might come off and soil the clothes.

Do You Think You Have Done a Good Job?
Answer these questions and decide for yourself.

1. Is the fork strong enough to stand the ordinary amount of strain?
2. Is the clothes stick smooth and free from pencil marks?
3. Is the hole in the handle 1″ from the end?
4. Why do you bore from both directions when boring a hole through a piece of wood?
5. Should a rip saw or crosscut saw be used for sawing out the handle?

JOB NO. 9

THE DRAWING FOR ANOTHER CLOTHES STICK

Perhaps the clothes stick in the preceding job looks too difficult. Here is another one which is easier. See if you can make your own plans for doing the job.

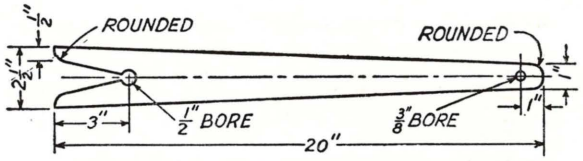


Fig. 56—Another design for making a clothes stick

Job Test

1. What size piece of stock should be cut for this clothes stick?
2. How many surfaces should be dressed with a plane before the layout is made?
3. What number auger bit is used to bore a ½-inch hole?
4. What tool should be used to remove pencil marks?
5. What is the meaning of ½-inch bore?

JOB NO. 10

HOW TO MAKE A NAIL BOX

Every home has need of a box in which to keep nails or screws, sorted according to size. Otherwise, the nails and screws become so mixed that the size wanted can never be found when needed. Making a good box is really quite an accomplishment. However, if instructions are followed carefully, there is no reason that the ordinary person should not be able to make a good nail box.

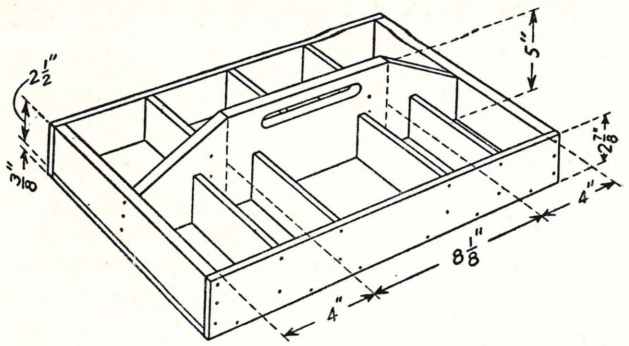


Fig. 57—The nail box

Materials Necessary:

As the household mechanic becomes more experienced in woodworking, he plans bigger jobs. He should be able to figure a bill of materials from a drawing. Get a piece of paper and rule off a form similar to the one given below. Then answer the following questions, and the bill of materials will be filled out.

BILL OF MATERIALS FOR THE NAIL BOX

No. Pieces	Kind of Material	To Be Finished to Size:
2 sides	white pine	⅜″×2⅞″×18⅛″
2 ends	white pine	
1 bottom	white pine	
1 centerpiece	white pine	
7 divisions	white pine	

1. What size material will be needed for the sides? This answer is already filled out.
2. What size material will be needed for the ends? The thickness is given in the drawing as ¾″. Notice that the width will be ⅜″ less than the sides because the bottom is nailed to the underneath side of the ends. The length will be the width of the nail box less the thickness of the two sides.
3. What size will be needed for the bottom? The thickness of the bottom is given on the drawing. The width will be the same as the length of the ends. The length will be the same as the length of the entire nail box.
4. What size material will be needed for the centerpiece? The thickness is given on the drawing. The width is given on the drawing. The length would be the length of the entire nail box less the thickness of the two ends.
5. What size material will be needed for each of the divisions? The thickness is given. See if you can figure out the width and length.

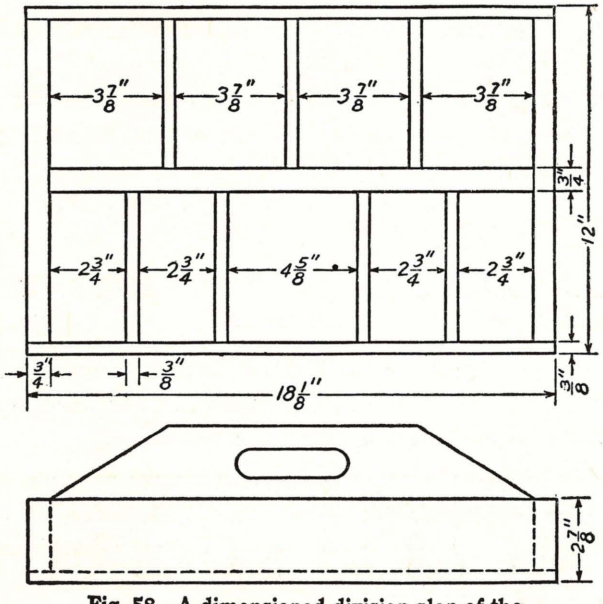


Fig. 58—A dimensioned division plan of the nail box shown above

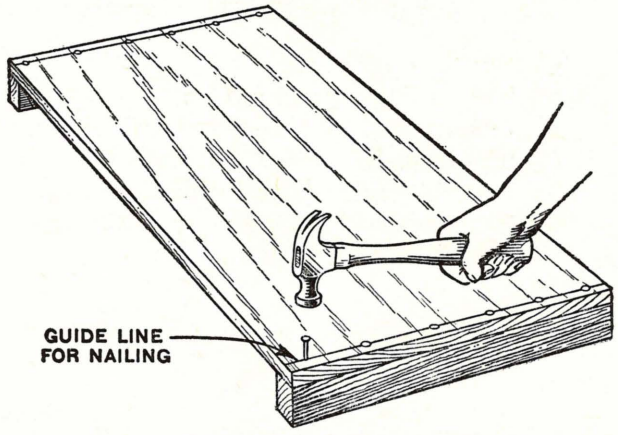


Fig. 59—A guide line may be drawn for nailing the bottom to the ends

Here Is a Plan for Making the Nail Box. Procede carefully because this is a big job.

1. Finish each piece to size. See instructions for finishing to size, pages 10 and 11. It saves time to tack the two sides, the two ends, etc. together when planing the edges and sawing the ends.
2. Nail the bottom to the ends. A guide line for nailing can be drawn across the end of the piece being nailed, about half the thickness of the piece being nailed to, from the end.

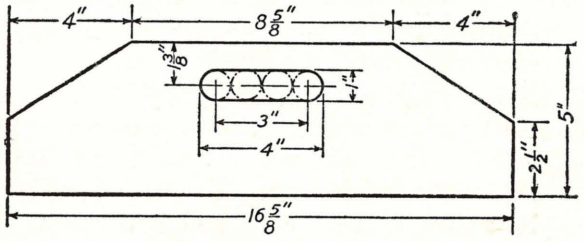


Fig. 60—The layout for the centerpiece

3. Nail the sides to the ends and bottom. Be extremely careful to drive the nails straight. If a nail should split the bottom, draw it and drive another nearby.
4. Lay out the design of the handle. Refer to the drawing for dimensions.

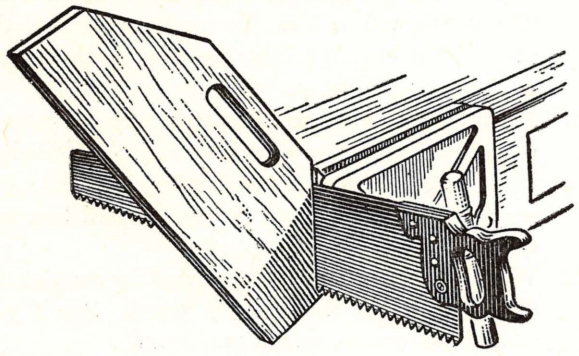


Fig. 61—Saw off the corners with a crosscut saw

5. Cut out the centerpiece.
   (*a*) The sloping corners can be cut off with a crosscut saw, and then finished with a plane.
   (*b*) The hand hole should be bored with a 1″ auger bit and smoothed with a wood chisel.
   (*c*) Remove the sharp arrises from the top of the handle with a plane.

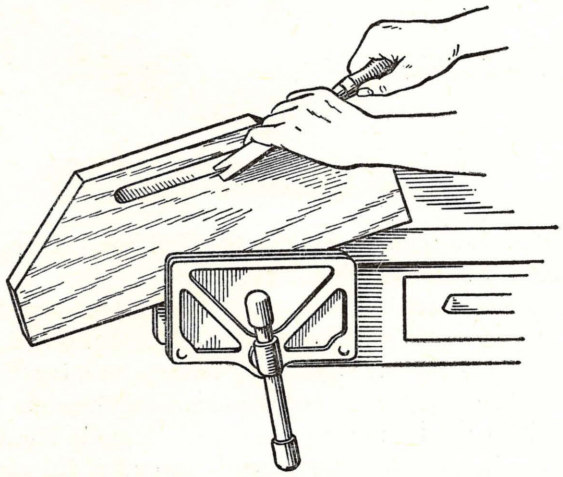


Fig. 62—The hand hole is smoothed with a wood chisel

6. Fit the centerpiece and partitions into the box. Some adjustments may be needed. Do not do any nailing until they all fit.
7. Nail the partitions to the centerpiece.
8. Nail the assembled divisions and centerpiece into the box. The divisions must be nailed to both sides and bottom. The centerpiece must be nailed to both ends and bottom. Guide lines will help in nailing. Nails and screws are heavy and the box is likely to come apart unless fastened together securely.

   Sometimes a strip of sheet metal or strap iron is used to reinforce the handle. It is a good idea, because the handle sometimes splits.
9. Paint or stain the box as desired.

Here is another plan for the nail box which may be preferred to the one just described. The divisions are more difficult to make, but otherwise it is very similar. This one may be made instead of the other one if desired.

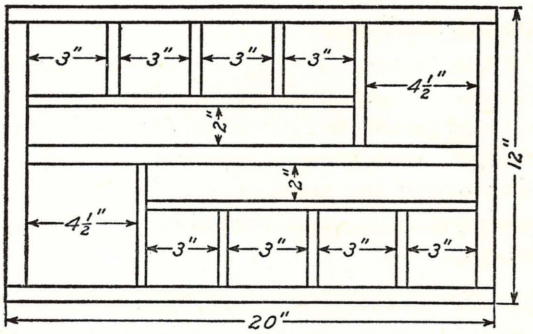


Fig. 63—This alternate division plan is suitable for either a nail or screw box. Note the space on either side of the handle for tools

How Good a Box Did You Make? Could You Make Another One Better? These questions may help you decide how well you did the job.

1. Is the box solid and well put together?
2. Is the box the size intended?
3. Do the corners and joints all fit well?
4. What tool is used to smooth the rough edges of the hole for the handle?
5. Can you imagine any particular reason for nailing the sides to the bottom instead of nailing the bottom to the sides?

JOB NO. 11

HOW TO MAKE HOLDERS FOR NAILS AND SCREWS

Here is another method of keeping screws and nails. They will always be handy, out of the way, and easily found when they are wanted.

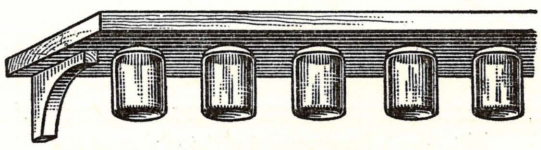


Fig. 64—A handy way to store screws

Get as many empty glass jars with screw tops as are needed, or as there is room to place under a shelf. Underneath the cellar stairs is a good place.

1. Punch two holes in the lid of the jar.
2. Bore pilot holes in the underneath side of a shelf or stairway.
3. Fasten the lid to the shelf with screws and washers.

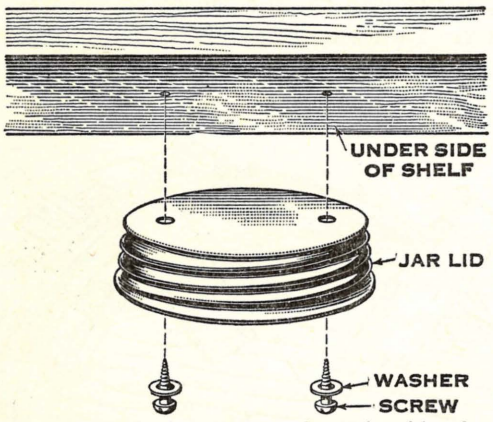


Fig. 65—Fastening the jar covers to the under side of a shelf

JOB NO. 12

HOW TO MAKE A BOOK RACK

When one takes a book from the library, he is under a very real obligation to return it in good condition. This is sometimes a difficult thing to do when there is no special place to keep the library book. However, a book rack can be made which will serve this purpose very well. If a little care is used, it can be made an attractive decoration for the room.

Materials Needed:

The kind of material needed depends upon the kind of finish desired. If the rack is to be painted, soft wood will do very nicely. If it is to be carved, either hard or soft wood may be used. But if a stain and varnish finish is desired, wood should be used which has an attractive grain. Here is a lumber bill for a book rack.

1 pc. for the bottom, $1'' \times 5\frac{1}{2}'' \times 16''$

1 pc. for two ends, $1'' \times 5\frac{1}{2}'' \times 14''$

If braces are to be used, 2 small pieces will be needed.

4 flat head screws to fasten pieces together.

Equipment Necessary:

The ordinary woodworking tools.

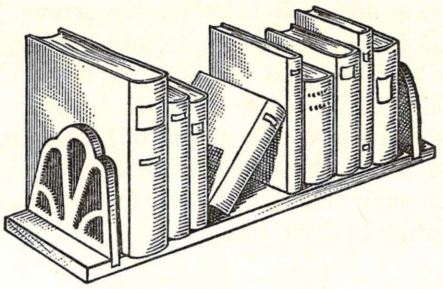


Fig. 66—A book rack

Here Is a Plan for Making a Book Rack. Use whatever design you like best. The procedure will be much the same.

1. Finish the pieces to the size desired.
2. Lay out the design for the ends.
3. Saw the ends to shape.

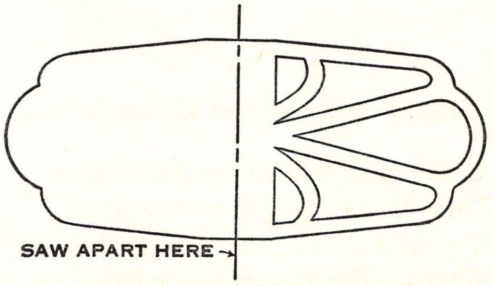


Fig. 67—Both ends are laid out on one piece and completely formed before being sawed apart

4. Smooth the edges. It is a good plan to clamp both pieces in the vise together and smooth them at the same time.

   Note: If a carved design is used, the carving should be done at this point.
5. Lay out the stock for the bottom of the book rack.

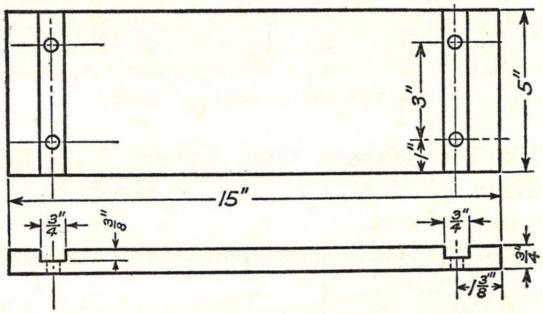


Fig. 68—The layout for the bottom of a book rack

6. Cut dado in bottom piece with a saw and $\frac{3}{4}''$ chisel. If the ends are to be fastened to the bottom with hinges or a simple butt joint, this step may be omitted.

7. Locate and drill holes for the screws. Notice that the holes in the bottom are larger than the shank of the screws to be used, while the anchor holes in the ends are smaller. This is because a screw does most of its holding in the end piece, therefore this part must be tight. The screw should fit loosely in the bottom piece in order to drive easily.

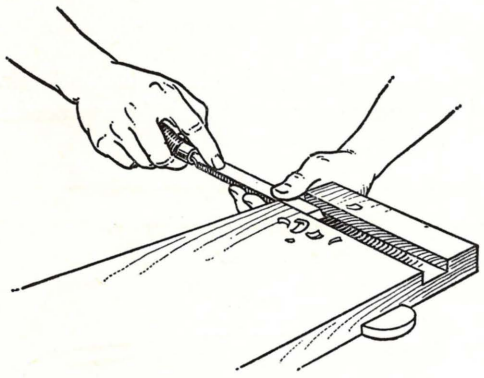


Fig. 69—Removing wood between saw cuts

8. Countersink holes in the bottom piece.
9. Drive the screws with a screwdriver.
10. The finish on the book rack may be of any type desired. For instructions in finishing, refer to the chapter on wood finishing.

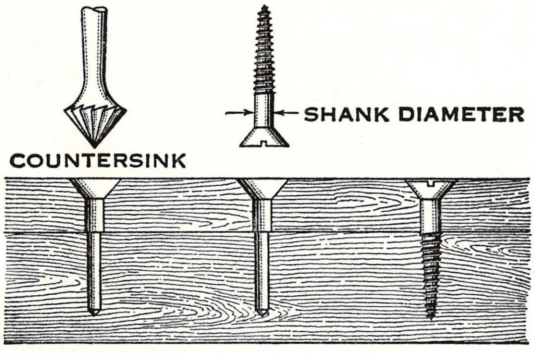


Fig. 70—Setting flat-head screws

Did You Make a Good Looking Book Rack?

These questions may help you decide how well you did the work.

1. Are the screws countersunk below the surface of the wood?
2. Are the ends strong?
3. Is the finish good?
4. Should a screw fit loosely, or tightly in the shank hole?
5. What tool is used to make the head of a flat head screw set below the surface of the wood?

JOB NO. 13

HOW TO MAKE A HOSE RACK

Keeping the garden hose hung on the hose rack when not in use, is a very important job. It is also important that the hose does not kink, or that the rubber and fabric do not become broken. If a good place is provided to keep the hose, it is much more apt to be cared for properly. This rack is designed to be attached to the wall of the garage. Notice that there is no danger of breaking the rubber or fabric of a hose on this rack.

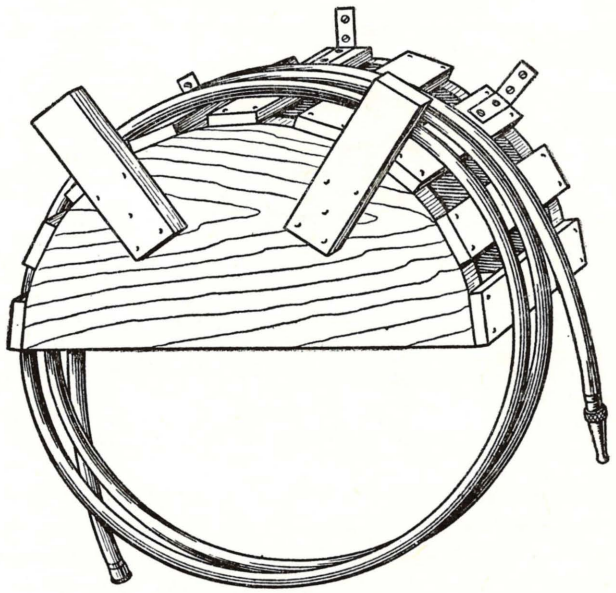


Fig. 71—This is a good type of rack for hanging the hose when not in use

Materials Necessary:

The household mechanic should be able to make out his own bill of materials from the drawings.

Equipment Necessary:

The ordinary woodworking tools will be needed.

Here Is a Plan for Making the Hose Rack.

1. Lay out the design for the two semi-circles. A pair of 10″ dividers will be needed for this job.
2. Cut out the circle with a turning saw. A coping saw is too light for this job.
3. Cut the slats which are to be nailed to the semi-circle. It probably will not be necessary to finish these pieces, but they should all be the same size. Rough-sawed edges should be planed.
4. Nail the slats to the semi-circle. They should all be spaced evenly. A good way to do it is to

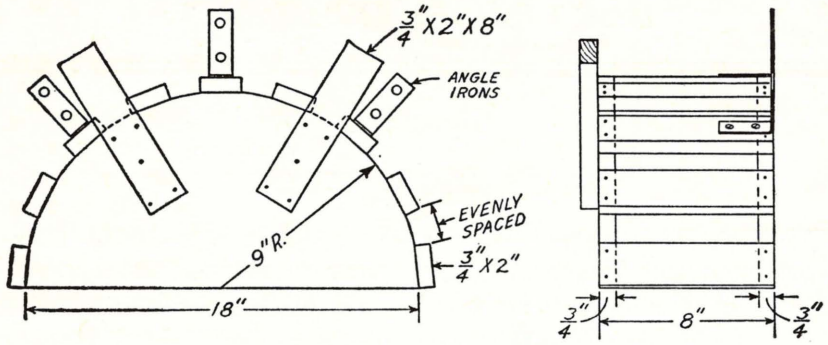


Fig. 72—Working drawing of the hose rack

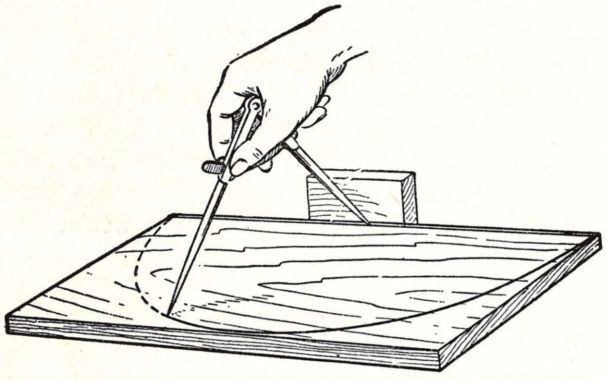


Fig. 73—The semi-circle should be laid out with a pair of 10″ dividers

nail the center one, and the two end ones first. Then space the others as evenly as possible.

5. Nail the two slats which serve to keep the hose from falling off, to the side of the semi-circle.
6. Attach the angle irons with screws, in the locations as illustrated in figure 72.
7. Paint the hose rack if desired.
8. Attach the hose rack to the wall of the garage by means of the three angle irons, as illustrated. Screws should be used instead of nails.

Are You Satisfied With the Job Now That It Is Completed? See if you can do as well on these questions.

1. How large a circle has a 9″ radius?
2. Why should screws be used instead of nails in fastening the hose rack to the wall?
3. What is the difference between a turning saw and a coping saw?
4. What size nails would you recommend for this job?
5. What kind of screws would you use for this job?

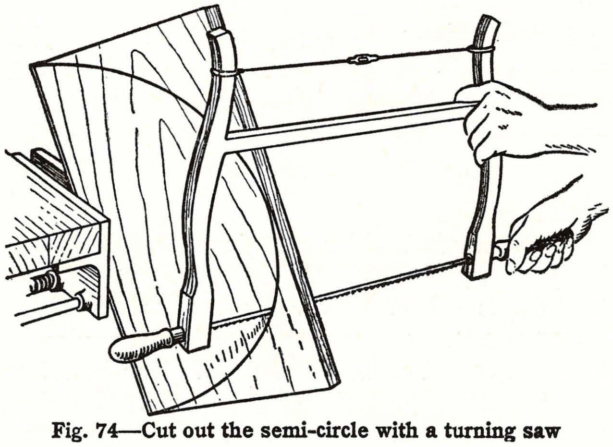


Fig. 74—Cut out the semi-circle with a turning saw

Metal Working

Chapter 2

FACTS ABOUT METALS

METAL is being used more and more to make articles which were formerly made of wood. In fact so many things are now made of metal that the period is known as the "metal age." However, many people lack confidence when they find it necessary to work with metal. This is probably because they have had little experience with it. Nevertheless, it will be found just as easy to make things in metal as in wood.

Sheet metal is metal which has been pressed or rolled out in thin sheets. Sheet metal is manufactured in many thicknesses which are referred to by gage numbers. Gage 28, being very thin, requires about 60 sheets to equal an inch. Gage 12 which is very thick, takes 10 sheets piled one on the other to make an inch. Black iron, galvanized iron, copper, brass, aluminum, tin plate, and zinc plate are common kinds of sheet metal.

Galvanized Sheet Iron

Galvanized sheet iron is made of ordinary sheet iron which has been coated with zinc by dipping the sheet in melted zinc. It has a frosty appearance. The zinc prevents the iron from rusting. Galvanized sheet iron is used for many of the heavier utensils in the home, such as wash tubs, pails, etc. It is used for eave troughs, rain spouts, and sometimes for roofing. The household mechanic will find many uses for galvanized sheet iron.

Tin Plate

Everybody is familiar with tin plate, but few call it by its right name. The common vegetable or fruit can is called a tin can, but really there is very little tin in it. The can is made of sheet iron which has been coated or plated with tin. The iron sheet may be plated by dipping in melted tin. The sheet may also be plated by electricity. The proper name for the metal from which the can is made, is tin plate when coated with tin, or terne plate when plated with a mixture of tin and lead. The household mechanic will find many uses for tin plate around the home. In fact, many useful articles may be made from the tin can. So the household mechanic should learn how to do the common operations in working with tin plate. The thickness of tin plate ranges from approximately .006 to .050 inch.

Cast Iron

Cast iron is melted and poured into molds. It is very brittle and will not bend. The shape of cast iron cannot be changed except by cutting it, or by melting it up and casting it over again. If it is struck a hard blow with a hammer, it is apt to break. Cast iron is very strong. It is used for making so many different articles that it is impossible to name them. Among some of the common household articles, are hot water heaters, stoves, furnace parts, and radiators. It can be brazed or welded but not soldered.

Wrought Iron

Wrought iron which is usually soft and pliable, can be bent when either hot or cold. A blacksmith can form wrought iron into many shapes by hammering when it is "red hot."

Wrought iron is usually sold in the form of bars, or straps. During the past few years, cold-rolled steel has taken the place of wrought iron for many things. It is now used by the workers in ornamental iron, because it is cheaper, and just as easy to work.

Steel

Steel is made from iron. There are many methods of making steel, each of which produces special qualities. In general, it is safe to say that small percentages of carbon are added to molten iron to make steel. Common steel is harder and stronger than either wrought iron or cast iron. It can be formed into shapes when heated "red" or "white hot," and is used to make machine parts.

Tool Steel

Tool steel, which is a much more refined form of steel, is used to make tools such as knives, cutters, drills, screwdrivers and wood chisels. Some tool steel is very hard and brittle. This grade is used in making knives, razors, wood chisels, etc. Other tool steel is soft and tough, such as is found in hand saws and auger bits. Clock springs, and many other kinds of springs are made of steel.

Wire

Wire can be made from almost any kind of metal. The most common kinds are iron, steel, and copper. Wire is made from bars or rods of metal which are softened and drawn through holes in steel dies to make the desired sizes. The diameter of wire is expressed by a gauge number.

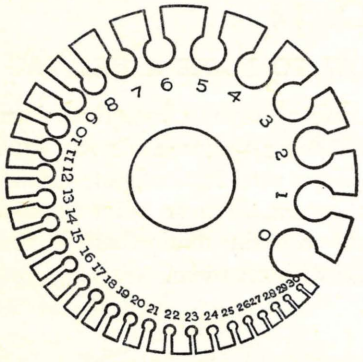


Fig. 75—Scale showing the size of wire according to gauge

Wire is made in gauges as fine as hair and as large as $\frac{1}{4}$" in diameter. Wire is usually sold by weight, but electrical wire in small quantities is sold by the foot.

Iron wire is very handy to use for repair and construction purposes. It can be made soft and pliable by heating it "red hot" and allowing it to cool very slowly. This process is called annealing. Unfortunately, iron, as well as steel, wire rusts easily and should not be used where it is exposed to the weather.

Galvanized wire is the same as black iron wire except that it is coated with zinc to make it rust proof.

Working With Metal In the Home

Scraps of wrought iron, and the various kinds of sheet metal, provide material for the household mechanic to make many interesting things in metal. Much of this material can be salvaged from worn out or waste material. Sheet metal may be cut with the tinner's snips, and easily bent into the desired shapes. Pieces of sheet metal may be fastened together by riveting or soldering. Scraps of iron may be cut with a hack saw or cold chisel. A blacksmith may fasten pieces of scrap iron together by welding, but the household mechanic will find it necessary to use rivets for this purpose.

Soldering

Soldering is the process of joining two pieces of sheet metal together with solder. It is used only for lighter metals such as sheet metal or wire. For the heavier metals, such as castings, some form of welding is used.

There are two common methods of soldering. The one which has proved to be the most practical is by the use of a soldering copper, which is called also a soldering bit, or soldering iron. The other is with the air of a torch which necessitates more equipment than is usually found in the home workshop.

Fig. 76—A soldering copper

The Soldering Copper

The point of the soldering copper, used to melt solder and draw it wherever desired, is made of copper. Copper is used because it is easily heated and gives off heat readily.

Solder

Solder, a mixture of tin and lead, is soft and easily melted. It does not rust. When melted it sticks readily to such metals as tin, copper, and zinc. Solder can be purchased in bar or wire form at the hardware store.

Aluminum cannot be soldered with common soft solder. Special solder and a torch are needed, and these articles are not usually found in the home work shop.

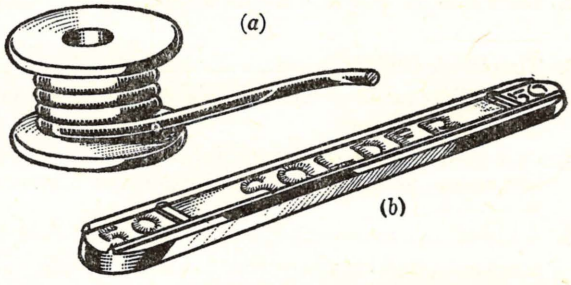


Fig. 77—(*a*) A spool of wire solder. (*b*) A bar of solder

Soldering Flux

Flux must be used on surfaces to be soldered. When applying solder to metal, the surface must always be clean. Paint, rust, or dirt must be scraped off with a knife or a file. In addition, a protective coating of flux must be spread over the surface. This further cleans the surface, and helps prevent the hot soldering copper from burning the metal. It also causes the solder to flow more easily and evenly.

Different fluxes, prepared for various metals, can be purchased ready for use. Some fluxes are made for soldering all metals, while others for only one. Sal ammoniac is usually the best for tinning soldering coppers. Rosin is good for soldering tin, or for all metals that are scraped or filed bright. Killed acid, made by dissolving zinc in muriatic acid until it stops boiling, is good for soldering zinc or galvanized iron. The druggest will mix five drops of hydrochloric acid to an ounce of glyerine as a flux for soldering copper, brass, and pewter. The household mechanic will find paste flux, or soldering paste, the most convenient to use around the home.

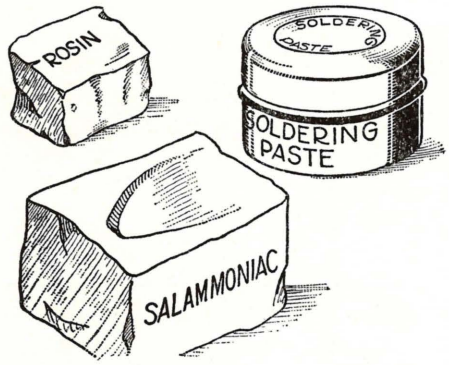


Fig. 78—Soldering fluxes

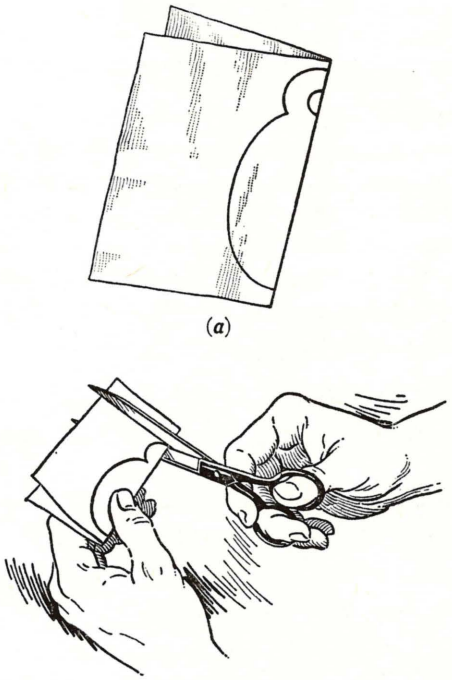
Here Are Some Questions to Test Your Knowledge of Metal.

1. Sheet metal 10 gage is _____ than sheet metal 28 gage.
2. Black iron covered with a thin coating of zinc is called _____.
3. Tin plate is made of _____ _____ coated with tin.
4. Castings are made by melting metal and pouring it into _____.
5. Cast iron must be _____ before it can be formed into shapes, as it will not bend, nor can it be hammered into shape.
6. A blacksmith uses wrought iron or cold-rolled steel for ornamental iron work because it _____ easily.
7. Steel can be forged into shape when it is heated white or _____ hot.
8. Common steel is used for making machinery because it is _____ than cast iron or wrought iron.
9. Solder is a mixture of _____ and _____.
10. Aluminum requires _____ solder.
11. What is used to clean the surface of metal about to be soldered?
12. For what is sal ammoniac used?
13. What is a good flux for galvanized iron?
14. The diameter of a wire is expressed by a _____ number.
15. Iron wire can be made soft and pliable by _____.
16. Iron wire _____ easily when exposed to the weather.
17. Galvanized wire is iron wire coated with _____.
18. Iron can be cut with a _____ or a cold chisel.
19. Thin sheet metal can be cut with a pair of _____.
20. Chisels, plane blades, and screwdrivers are made of _____ _____.

JOB NO. 14

HOW TO MAKE A KEY TAG

When a ring of keys is lost, there is much more chance of its being returned if some kind of tag is attached. Keys used in the home often need some kind of marker on them to tell what lock they fit. Key tags are so easily made there is no reason for anyone to be without them.



(*a*)

(*b*)

Fig. 79—Cutting a paper template. (*a*) Design drawn on folded paper. (*b*) Cutting the template with a pair of shears

Materials Needed:

A piece of sheet metal large enough to cut out the desired size of tag. Heavy gauge aluminum, brass, or copper sheets are suggested.

Equipment Needed:

Scratch awl for tracing the design, tinner's snips for cutting the tag to shape, a drill or solid punch for making the hole, and a file for smoothing the rough edges. Markings may be put on tags with

Fig. 80—Suggested designs for key tags

various kinds of punches, or by a process known as etching.

Here Is a Plan for Making a Key Tag. You Are to Use the Design You Like Best.

1. Lay out the design on a piece of heavy paper. This process is known as making a template. In making the template, it is important that both sides be the same shape. In order to be sure of this, fold the paper and draw half the design, using the fold as the center. (See Fig. 79.)
2. Cut out the template. Be sure to keep the paper folded while cutting, so both sides will be alike.
3. Trace the design on the metal. This is done with a scratch awl instead of a pencil because pencil lines rub off too easily.
4. Cut the tag to the proper shape with the tinner's snips.
5. Punch or drill the hole. If the metal is quite thin, the hole may be punched with a solid punch. If the metal is thick, the hole should be drilled.

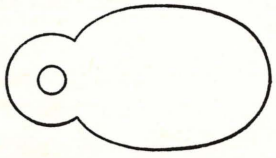


Fig. 81—Metal cut to shape for a key tag

6. Smooth the rough edges with a file.
7. Place the desired markings on the tag. This may be done in several ways as follows:
   (*a*) Use a sharp instrument to punch the outline of the letters or numbers desired. It is well to do the lettering in pencil first, in order to have an outline to follow.
   (*b*) Punch the letters into the tag with a letter punch. In this case it is well to draw a guide line with a pencil, to use as a guide in punching.

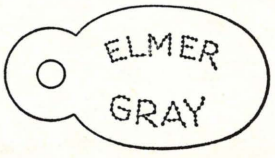


Fig. 82—Design punched with a sharp instrument

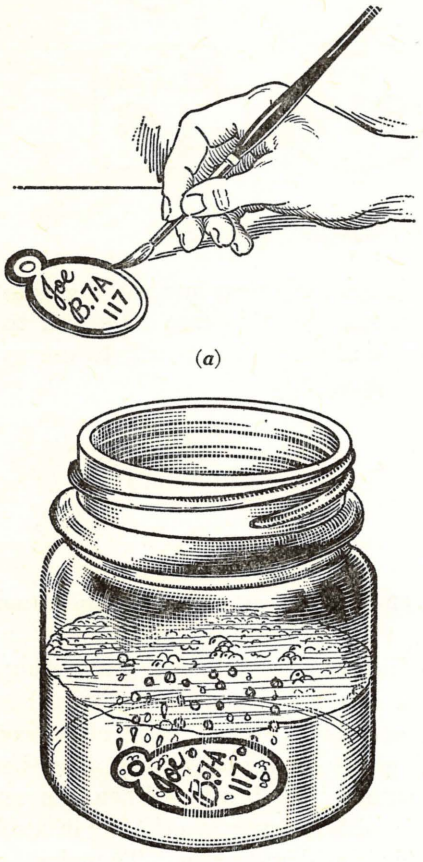
   (*c*) The most artistic and interesting method of marking is etching. Cover the parts to be raised with a protective coating of asphaltum varnish which may be applied with a fine brush. When the asphaltum varnish is dry, place the tag in a solution of nitric acid and water. To make the etching solution, pour one ounce of nitric acid into

Fig. 83—Marked with letter punches

a glass or porcelain jar, containing two ounces of water. When the acid has eaten out enough of the metal, remove the tag. This process usually requires about one hour.

Caution: Acid is dangerous to handle. Do not get any of it on the hands or clothing. When the acid is not in use, keep the jar tightly closed, and out of the reach of small children. Label it POISON. Do not keep acid near tools, as the fumes will cause them to rust.

8. Polish the tag. It is a good plan to remove the asphaltum with kerosene. Then polish with No. 00 steel wool. Bon Ami, or any good nickel or metal polish, may be used to obtain a bright finish.



(*a*)

(*b*)

Fig. 84—Etching. (*a*) Marking the design with asphaltum. (*b*) Etching the key tag in the acid solution

Here Is a Standard by Which You May Judge Your Work. Answer these questions:

1. Do you like the design?
2. Is the tag the same size and shape as the template?
3. Is the marking neatly done?
4. Why was the paper folded when cutting the template?
5. What tool was used to smooth the edge?

JOB NO. 15

HOW TO MAKE CLOSET ROD HOLDERS

People are often judged by the clothes they wear. This does not mean that expensive clothes are necessary, but it does mean that those worn should be kept clean and well pressed. This is easy to do if a proper place is provided to keep them. A rod put up across the closet with a pair of closet rod holders, makes an excellent place to keep clothes on hangers.

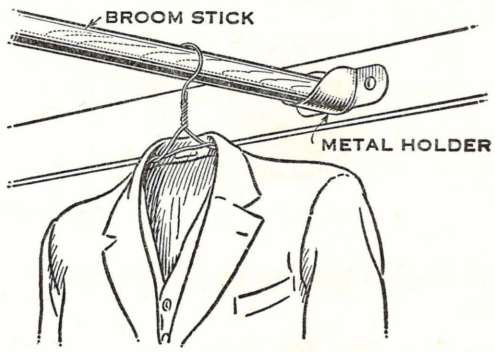


Fig. 85—Closet rod holder in use

Materials Needed:

A piece of sheet metal large enough for two holders.

Equipment Needed:

A pair of tinner's snips, a cold chisel, a solid punch and a file.

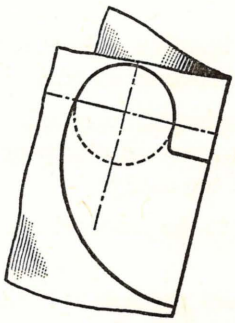


Fig. 86—The paper template is folded for cutting

Here Is a Plan for Making a Pair of Closet Rod Holders. It is well to check each step to prevent making an error.

1. Study the working drawing, and make a template out of a piece of heavy paper or cardboard. Draw the center lines first. (See Fig. 79.)

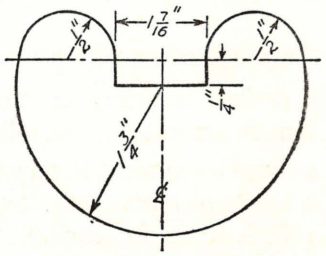


Fig. 87—The working drawing for a closet rod holder

2. Lay out the design on the metal by marking around the template with the scratch awl. Two pieces should be laid out. Be sure to mark the holes for the ears.
3. Cut out the holders, using the tinner's snips, cold chisel, and the solid punch.

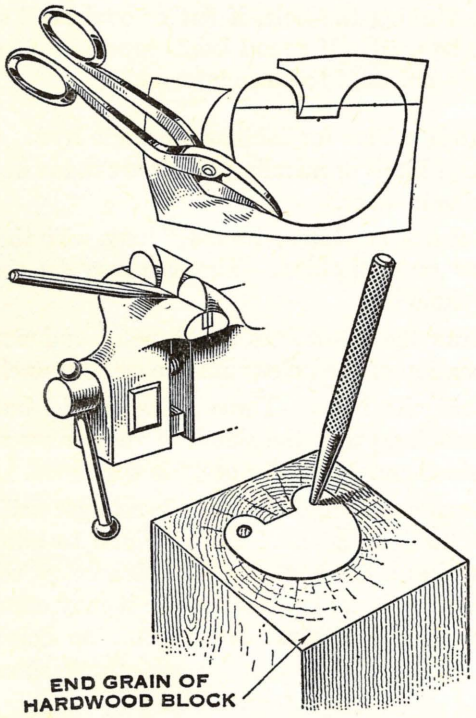
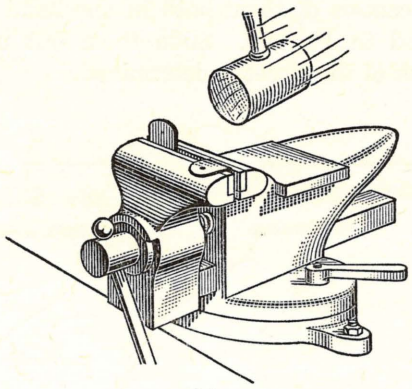


Fig. 88—Cutting the metal to shape with tinner's snips, the cold chisel, and punch

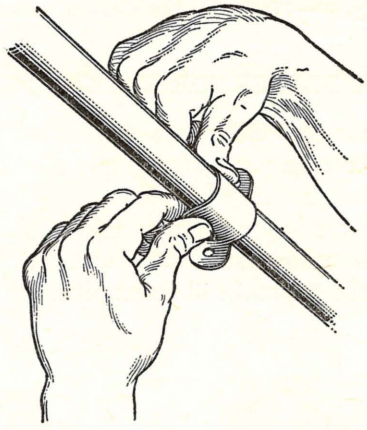
4. File the rough edges smooth. Tiny slivers of metal if not removed, may tear the clothing or cut the hands.
5. Fold the ears to right angles in a vise. A wooden mallet should be used rather than a hammer, because the hammer may dent or break the metal. (See Fig. 89 (*a*).)
6. Bend the body to the desired shape over a pipe or round iron bar. It may be necessary to use a mallet or pair of slip joint pliers to bend the metal to shape. (See Fig. 89 (*b*).)

Now That You Have Finished the Holders What Do You Think of Them? Perhaps these questions will help you decide how well you did the work.

1. Are there any sharp corners which may scratch the hands?
2. Are the holes in the center of the ears?
3. Are both holders the same size and shape?
4. What kind of punch is used to punch small holes in sheet metal?
5. Does the cold chisel have a wedge edge, or a beveled edge?



(*a*)



(*b*)

Fig. 89—Shaping the closet rod holder. (*a*) Bending the ears to right angles. (*b*) Forming the curve

JOB NO. 16

HOW TO INSTALL CLOSET ROD HOLDERS

The mere fact that you have made the holders has not solved your problem. It is after you have put them to use that you will receive the full benefit. Here are some hints on putting them up in the closet at home.

1. Get four 1″ round head screws, a drill smaller than the screws, a broomstick long enough to reach across the closet, and a screwdriver.
2. Select the place in the closet for the holders, and mark the location for the screws.
3. Drill the pilot holes and fasten the holders in place with the screws. Pilot holes are necessary to prevent splitting the wood or cracking the plaster.
4. Cut a broomstick to the proper length, and lay it in place. Here is a suggestion for finding

the length of the stick needed. Get two sticks shorter than the width of the closet, and hold the centers of them both in one hand as illustrated in Fig. 90. Slide them out until the width of the closet is determined.

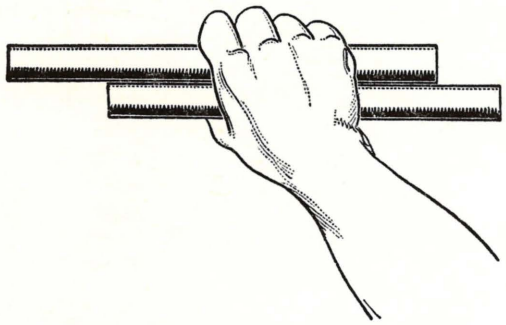


Fig. 90—Measuring the width of a closet

MENDING PLATES FOR BROKEN FURNITURE

The joints in window screens, screen doors, and furniture become weak after years of constant use. In this condition they are not safe to use. It is a simple matter to strengthen these joints so that they will be strong and serviceable. A few screws and some sheet metal will accomplish the task. (See Fig. 91.)

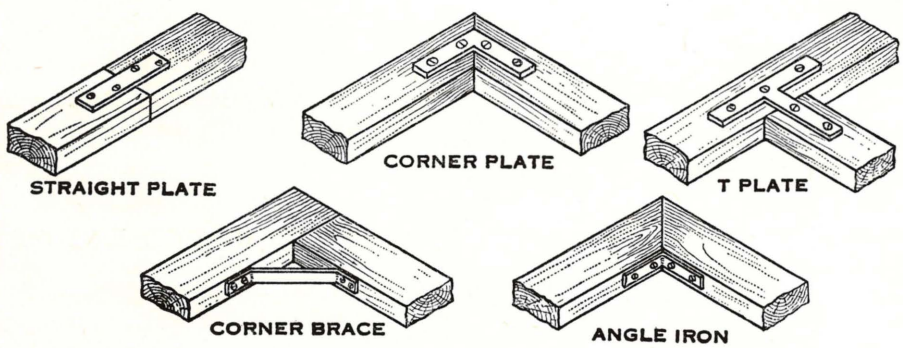


Fig. 91—Types of mending plates

JOB NO. 17

HOW TO MAKE AN ANGLE IRON

An angle iron is used on the inside angle of a door or chair which has become weak or broken. Sometimes it is used to fasten the leg of a table or other object to the floor.

Materials Needed:

A piece of strap iron, or heavy sheet metal $\frac{1}{8}'' \times \frac{3}{4}'' \times 3\frac{1}{2}''$, and screws for installing. Flat head screws should be used.

Equipment Needed:

A hack saw, cold chisel, center punch, screwdriver, and a drill. The size drill depends upon the size screw to be used. A No. 10 screw needs a $\frac{13}{64}''$ shank hole. A No. 7 screw needs a $\frac{5}{32}''$ shank hole. A $\frac{3}{8}''$ drill or a countersink will be needed for countersinking the hole, if flat or oval head screws are to be used. If round heads are to be used, the holes do not need to be countersunk.

Here Is a Plan for Making an Angle Iron. Other sizes and kinds of mending plates are made in much the same manner.

1. Cut a piece of strap iron, $3\frac{1}{2}''$ long, with the hack saw or cold chisel. The size may be changed if desired.
2. Draw the center lines on the metal, and mark the location of the holes with the center punch.
3. Drill the holes. These holes should be large enough so that the shank of the screws will fit into them. The size of $\frac{1}{4}''$ is suggested.
4. Countersink these holes with a larger drill, or a metal countersink. This is done to allow the head of a flat head screw to sink below the surface of the metal. Otherwise it may catch and tear the clothing. The top of the hole when countersunk should be about $\frac{3}{8}''$.

   Note: Round head screws are generally used in a shelf brace. In that case it is not necessary to countersink the holes.
5. Smooth the surface with a file and an emery cloth. It should be as smooth as possible in order to look well, and also to prevent the

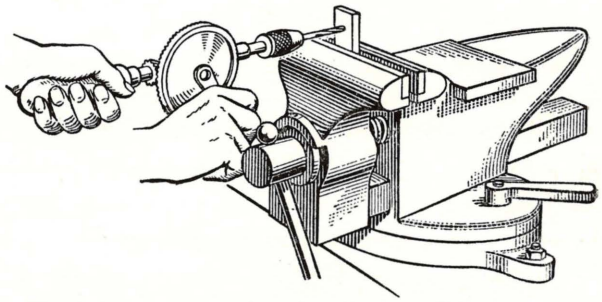


Fig. 92—The size of the hole to be drilled will depend on the size screw to be used

rough edges of the metal from catching the clothing or hands.

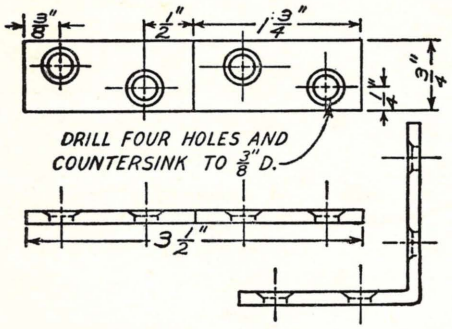


Fig. 93—Working drawing for a mending plate

6. Bend the iron to right angles. This can be done by placing the metal in a vise and bending it with a hammer.

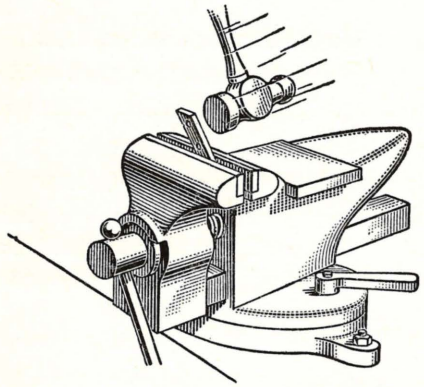


Fig. 94—A piece in vise being bent to right angles

Are You Satisfied With the Job? These questions may help you determine how well you have done the work.

1. Is the angle iron smooth and without sharp edges?
2. Do the screws fit below the surface of the metal?
3. Are the screws evenly located?
4. What size holes did you drill for the screws?
5. How do you intend to use the angle iron?

JOB NO. 18

HOW TO INSTALL AN ANGLE IRON

The angle iron, or any other form of mending plate which you have made is of no use until it is installed. It is very important that this be done properly.

Here Is a Plan for Installing the Angle Iron. The angle iron is of no use until it is installed. Here is a way to install it.

1. Place an angle iron in the position where it is to be installed.
2. Mark the anchor holes for screws with a pencil.
3. Drill the anchor holes. These holes are to prevent the wood from splitting.
4. Drive the screws into place with the screwdriver.

Here Are Some Questions to Help You Find Out How Much You Have Learned.

1. What size anchor holes did you drill?
2. Why should the anchor holes be smaller than than the shank holes?
3. Why are anchor holes drilled?
4. Is it always necessary to drill anchor holes in soft wood?
5. What happens when the anchor hole is too large?

JOB NO. 19

HOW TO TIN A SOLDERING COPPER

In order to use a soldering copper successfully, it is necessary that it be tinned. This means that about $\frac{3}{4}$ inch of the point is coated with a layer of tin when the copper is tinned. It will then draw the melted solder along a seam like a brush. If the copper is not tinned, the solder will not follow it. A soldering copper covered with dirt or oxide will not give off so much heat as a tinned soldering copper and the melted solder will not adhere to it.

You Will Find Tinning a Soldering Copper an Easy Task, if You Follow This Plan:

1. Heat the soldering copper to the proper temperature in a stove, furnace, with a blow torch, or with anything which will provide sufficient heat. The soldering copper is sufficiently hot when it will melt solder thin enough to flow like liquid. If the soldering copper is permitted to become "red hot," it will not hold tin until it cools to the proper temperature.
2. Clean the soldering copper. If the copper is covered with dirt or scale, it should be cleaned with a file. Solder will not stick to a dirty copper. If it is covered only with dirt from the fire, wipe it off with a piece of cloth.
3. Place a piece of soft solder on a block of sal ammoniac and rub the hot soldering copper on this block in contact with the solder. As soon as the point of the copper is clean, the solder will stick to it, making it bright and shiny like a new dime. If a liquid flux is used to clean the copper, the point should be quickly dipped

in the solution, then rubbed into a pool of melted solder.

Note: It is always necessary to keep the soldering copper heated to the proper temperature. If a tinned copper will not make solder run like water, it should be reheated. The point of the copper must be shaped while hot on an anvil.

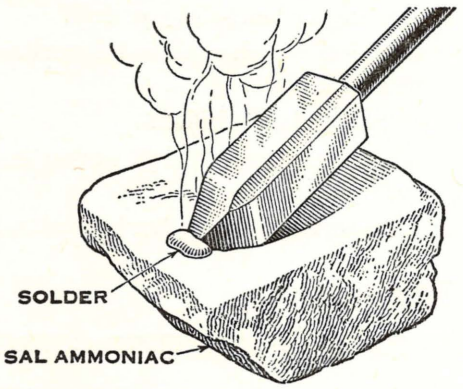


Fig. 95—Using a block of sal ammoniac to tin a soldering copper

Answer These Questions After Tinning The Soldering Copper.

1. Is the point of the soldering copper bright and shiny on all four sides?
2. What is solder made of?
3. Why is a soldering copper made of copper?
4. Why do you tin a soldering copper?
5. How can you tell when the soldering copper is hot enough to be tinned?

JOB NO. 20

HOW TO SWEAT A PATCH OVER A HOLE

When a tinned, brass or copper utensil has a large hole in the bottom, the best way to repair it is to solder a patch over the hole. This process is called sweating. Heat will not melt the patch off so long as there is water in the utensil. Do not try this on aluminum.

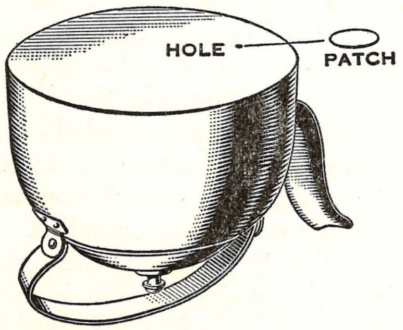


Fig. 96—The patch must be larger than the hole to be mended

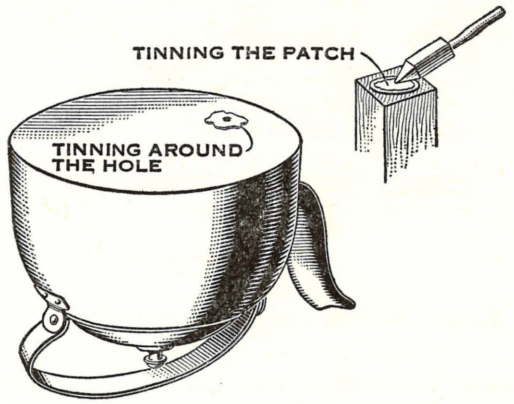


Fig. 97—Both the patch and the area around the hole must be tinned

Here Is the Way to Repair Such a Hole.

1. Clean the metal. Remember that solder will not stick to dirty metal, and flux will not remove the heavier dirt.
2. Cut a patch out of the same kind of metal as the utensil to be repaired. This patch should be at least $\frac{1}{4}$" larger all the way around, than the hole to be patched. See that the patch lies flat over the hole.

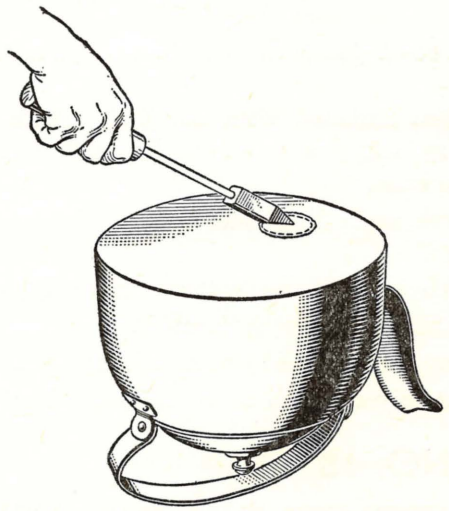


Fig. 98—The tinned surface of the patch is laid on the tinned hole and sweated in place with a hot soldering copper

3. Apply the flux to one side of the patch, and to the surface of the utensil around the hole to be repaired. Be sure to use the right kind of flux.

4. Tin a soldering copper. Even the expert cannot do a good job with an untinned copper. Do not make the mistake of trying it.
5. Tin one side of the patch, and the surface of the utensil around the hole which is to be repaired. This is done by melting solder on the point of a tinned soldering copper, and flowing it over the surface of the metal. This leaves enough solder on the surface of the metal to make the patch stick. (See Fig. 97.)
6. Place the tinned side of the patch over the hole and sweat it in place with the hot soldering copper. The patch may be held in place with the end of a file while the hot soldering copper is held flat on the patch. When the solder between the patch and the utensil is melted, the copper should be removed so as to allow the solder to cool. The file, however, should be held on the patch until the solder hardens. (See Fig. 98.)
7. Wipe off the surplus flux and test the utensil for leaks. Some fluxes will cause the metal to rust if they are left on the surface.

If You Have Done a Good Job, You Will Notice The Following Things to Be True.

1. The surface of the solder is smooth and shiny.
2. Very little solder has been used.
3. The utensil does not leak.
4. What kind of flux was used for cleaning the metal?
5. Why is it difficult for the household mechanic to solder aluminum?

JOB NO. 21

HOW TO SOLDER A SPLICE

The job is commonly used in electrical work, or in any work where wire is used.

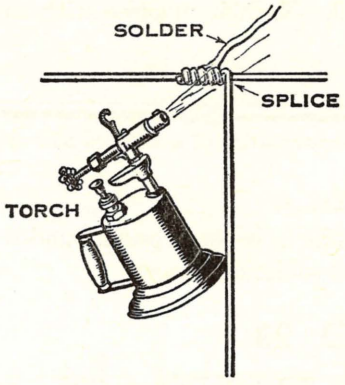
Materials:

In the first place, the household mechanic should remember that the wire in the splice must be clean. This, of course, should be done before the splice is made. If it was not done, the chances are that the soldering job will not be good. Anyway, it is better to try to clean a splice by scraping with a knife or rubbing with steel wool, than to try to solder it without attempting to clean it.

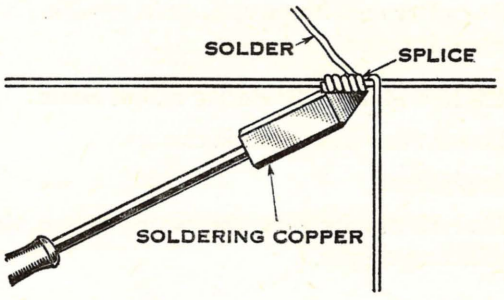
Here Are Two Methods of Soldering a Splice.

Method No. 1. Apply flux to the splice and hold over a flame. When it is hot enough to melt solder, remove from the flame, and apply as much solder as needed.

Method No. 2. Solder with a tinned soldering copper as for the ordinary soldering job.



(*a*)



(*b*)

Fig. 99—Soldering a wire splice. (*a*) With a torch. (*b*) With a soldering copper

JOB NO. 22

HOW TO SOLDER A WIRE LOOP

It is sometimes necessary to solder the ends of a wire together without making a splice. The main problem is to hold the wire firmly while soldering.

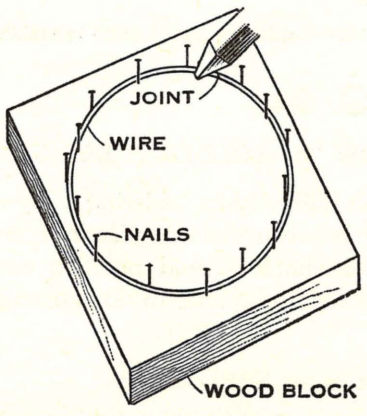


Fig. 100—Soldering a butt joint in a wire hoop

Here Are Some Suggestions:

1. Clean the ends of the wire to be soldered. This step is vital to all soldering operations.
2. Lay the wire flat on a board in the position to be soldered. Tack it in place with small nails or brads.

Fig. 101—Cross section of a soldered butt-splice in wire.

3. Apply flux.
4. Run solder in between and around the ends with a tinned soldering copper.

JOB NO. 23

HOW TO SOLDER A BUTT SEAM

Soldering a butt seam is often necessary in repairing the gutter on a house roof, or in repairing a leak in a sheet iron roof.

Here Is a Plan for Soldering a Butt Seam:

1. Be sure that the metal is clean.
2. Apply flux.
3. Flow the solder into the seam with a tinned soldering copper.

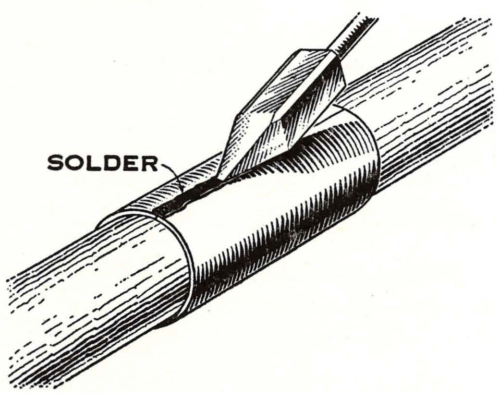


Fig. 102—Soldering a butt seam in making a tube

JOB NO. 24

HOW TO SOLDER A LAP SEAM

The main difficulty in soldering a lap seam is to flow solder between the two pieces of metal. The household mechanic should practice on pieces of scrap metal before he tries to do it on a good piece of work.

Here Are Some Suggestions:

1. Be sure that the surfaces to be soldered are clean.
2. Apply paste flux where the solder is supposed to stick.
3. Tin the soldering copper. The soldering copper must be very hot in order to give off enough heat to run the solder between the two pieces of metal.
4. Hold the soldering copper flat on the seam, and the solder will run between the two pieces of metal. Move the soldering copper slowly, allowing it to melt the solder so thin that it runs like water.

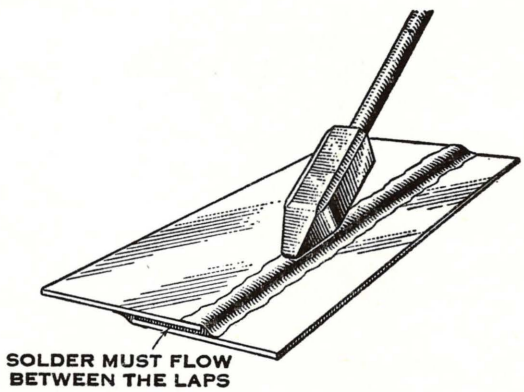


Fig. 103—Soldering a lap seam

JOB NO. 25

HOW TO SOLDER A LEAKY SEAM

The seam in a wash tub or pail is often the first part to leak. In this condition, the utensil is of little use, and should be repaired if not otherwise damaged. This is probably the most difficult soldering job the household mechanic will be called upon to do. It is difficult to get the seam clean enough that solder will run down into the seam. Once the metal is clean, it is as simple as any other job.

Here Is the Way to Do It Successfully. Each one of these steps is necessary for good work, so it may be a good plan to check them.

1. Clean thoroughly the part of the seam to be soldered. This means that all paint, dirt, or rust must be removed. *SOLDER WILL NOT STICK TO DIRTY METAL.* Be sure to clean down into the seam as far as possible. A knife, steel wool, or emery cloth may be used for this purpose.
2. Spread flux on the metal where solder is to be applied. Be sure to note the kind of metal to be soldered, as some require special fluxes.

3. Tin a soldering copper. Remember, an expert would not attempt to do a job with a copper which is not tinned.
4. Run solder into the seam with the soldering copper. A piece of wire or stick solder may be held in one hand, and the soldering copper in the other. As the hot copper is slowly drawn along the seam, the hot solder should run off the point into the seam. It is necessary that this be done slowly, however, in order that the metal may be hot enough to melt the solder.

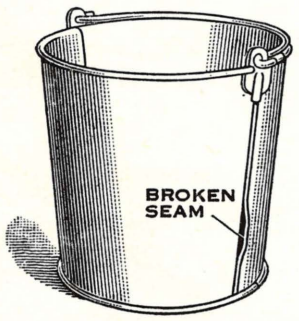


Fig. 104—A broken seam on a pail may be mended by soldering

A large soldering copper is best on this job, as it will give off more heat. *It may be necessary to reheat the copper several times before the job is completed.*

5. Wipe off surplus flux with a piece of cloth. Acid fluxes usually cause the metal to rust.

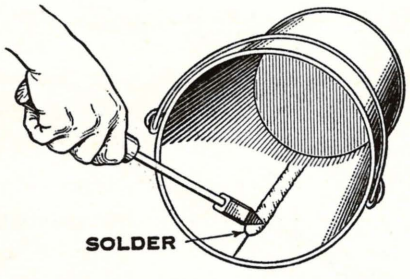


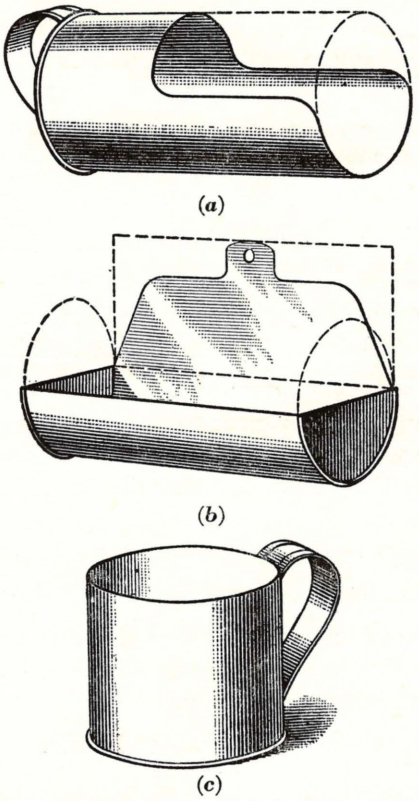
Fig. 105—The solder must be run into the seam with a hot soldering copper

Are You Satisfied With the Job Now That It is Done? If so, the following things should be true.

1. A layer of solder is spread evenly all along the seam.
2. The solder does not look dirty or rough.
3. The seam does not leak.
4. Surplus flux should be wiped off the surface.

ARTICLES MADE FROM TIN CANS

Many useful utensils can be made from tin cans which are ordinarily thrown away. Here are several things which are easy to make. They will be found useful in the kitchen, basement, or in camp.



(*a*)

(*b*)

(*c*)

Fig. 106—Articles that can be made from tin cans. (*a*) Tin can scoop. (*b*) Soap dish or match box. (*c*) Tin cup.

JOB NO. 26

HOW TO MAKE A TIN CAN SCOOP

A scoop will be found useful on many occasions in the home. It is excellent for the sugar or flour bin. A little brother or sister will probably enjoy a scoop for the sand pile. Just a little time and effort are necessary to make one.

Materials Needed:

A clean tin can about the size of the scoop desired, and some extra metal for the handle. A small can is suggested.

Equipment Needed:

A pair of tinner's snips, a scratch awl, a half round file, a rule, a mallet, and soldering equipment.

Here Is A Plan for Making the Tin Can Scoop. Follow the instructions carefully.

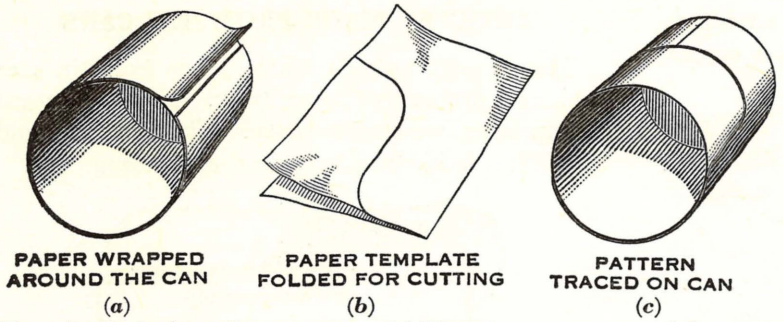


Fig. 107—Designing a tin can scoop. (*a*) Wrapping a paper around the can to make a template. (*b*) Folding the paper to cut the template. (*c*) Tracing the pattern on the tin can

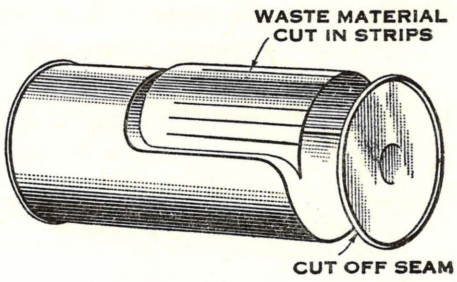


Fig. 108—Cutting the scoop to shape with a pair of tinner's snips

1. Wrap a piece of paper around the can; mark the curve for the side of the scoop.
2. Remove the paper, fold it in half, and cut out the template. This makes both sides of the scoop exactly alike.
3. Lay out the design on the can by tracing around the template with a scratch awl. Be sure to have the seam of the can at the top of the scoop.
4. Cut out the body of the scoop with tinner's snips. This can be done more easily if the metal to be removed is cut in narrow strips.
5. Smooth the rough edges with a half round file. No slivers or rough edges should be left to catch hands or clothing.
6. Lay out the design for the handle. (See Fig. 109.)
7. Cut the handle to shape with tinner's snips.
8. Fold a $\frac{3}{16}$" double hem on both sides of the metal. This makes the handle strong and easy on the hands. A hem may be made by placing the metal in a vise between two boards and bending the edges with a mallet.
9. Form the handle on a piece of pipe or iron rod. The top end of the handle should be bent at right angles to provide a better soldering surface where it fits on the end of the can.

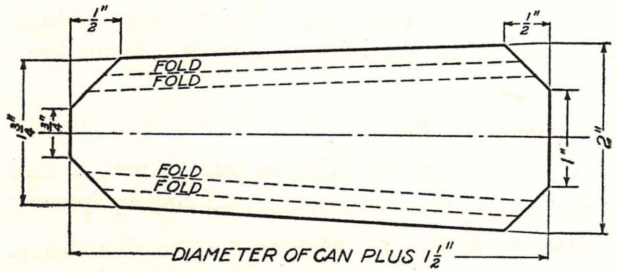


Fig. 109—The working drawing for the handle

10. Solder the handle in place (See page 34). Be sure to wipe off surplus flux with a cloth to prevent rust.

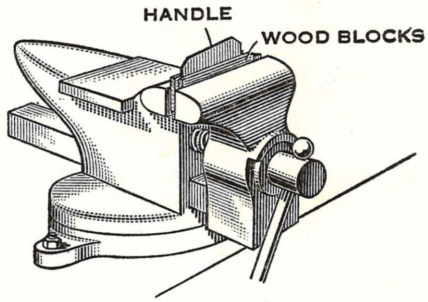


Fig. 110—Making a hem on the piece for the handle with the aid of a vise

Now That You Have Completed the Job, Are You Satisfied With It? Here are some questions to help you determine how well you did the work:

1. Are the curved edges the same on both sides?

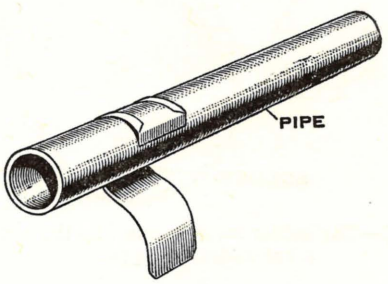


Fig. 111—Forming the handle

2. Is the handle soldered on well enough to stand a good hard pull?
3. Are there any sharp slivers of metal on the edges which might cut the hands?
4. Is the hem on the outside of the handle?
5. Of what kind of metal is a tin can made?

JOB NO. 27

HOW TO MAKE A FOOT SCRAPER

Spring with its rainy days means muddy shoes. A foot scraper will be very useful in helping mother keep her floors clean. Such a scraper may be fastened to the steps on the back porch, or to a block of wood or concrete, and set into the ground near the sidewalk. A scraper can be made very easily at home.

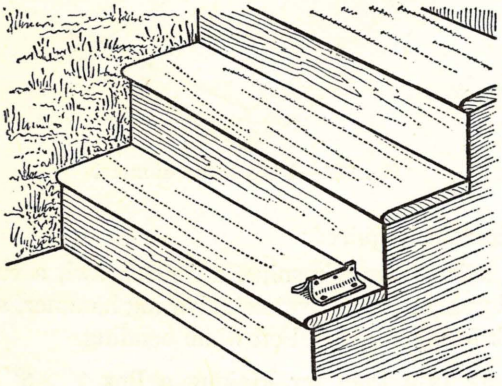


Fig. 112—The foot scraper

Materials Necessary:

Two pieces of heavy sheet metal, $3\frac{3}{4}''\times 6''$. About 20 gage metal is heavy enough, for it must be strong enough to stand the strain of scraping feet. Three rivets, size one pound, are needed. Wire nails may be cut off and used for rivets.

Equipment Necessary:

A scratch awl, rule, tinner's snips, solid punch, file, rivet set, and hammer.

Here Is a Plan for Making a Foot Scraper. Follow instructions carefully.

1. Lay out the design exactly the same on the two pieces of metal. Notice that the holes to be punched are marked by two intersecting lines.

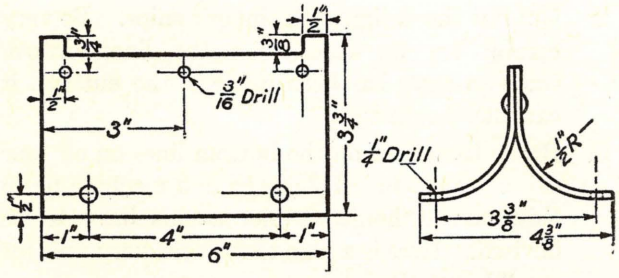


Fig. 113—The working drawing of a foot scraper

2. Cut each piece to shape with tinner's snips. This will have to be done carefully because the pieces have to fit together.
3. Clamp the two pieces together, and punch or drill the holes for riveting. The holes should be made through both pieces at the same time. If the metal is heavy the holes should be drilled.

   Caution: In punching holes the metal should be placed on a lead or wood block. The end grain of a piece of hard wood is excellent.
4. Rivet the pieces together. In riveting, there are several things to be done. The pieces to be riveted should be placed on a metal block or anvil with the head of the rivet down. (See Fig. 115.)

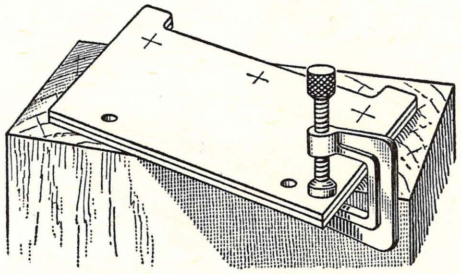


Fig. 114—Locating the holes for riveting the pieces together

5. Punch or drill the holes for fastening the scraper.
6. File the edges until they are even. It may be necessary to file off a great deal before they are even.

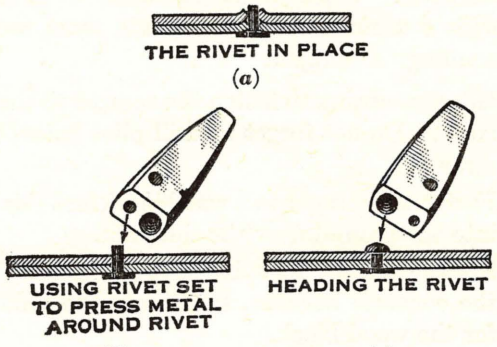


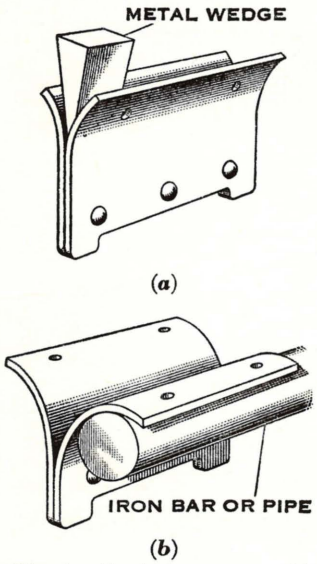
Fig. 115—Riveting. (*a*) The rivet in place. (*b*) Using a rivet set to press the metal around the rivet. (*c*) Heading the rivet

7. Bend the scraper to shape. Separate the ends with a chisel and shape by means of a mallet over a round iron bar.

Now That the Scraper Is Completed, Are You Pleased With the Job You Have Done?

1. Is the metal even all the way around?

2. Are there any sharp corners which would cut shoes?
3. Is the metal heavy enough to stand the strain?
4. What kind of a punch is used to center holes which have to be drilled?
5. Why is it necessary to center holes which are to be drilled?



(*a*)

(*b*)

Fig. 116—Shaping the foot scraper. (*a*) Spreading the piece. (*b*) Forming the curves

In its present form, the scraper is not much good to anybody. When it is installed at home, it becomes a useful article. Here are some methods of installing the scraper.

1. Get four screws to fasten the scraper to the back steps. Do not forget to drill pilot holes for the screws.
2. Fasten the scraper to a wood block; set this block into the ground near the sidewalk.
3. Set the scraper in a block of concrete. When the concrete hardens, set it into the ground as for the wood block.

JOB NO. 28

HOW TO MAKE A METAL BOX

Metal boxes can be used for a number of things around the home. On account of fire they are much safer than wooden boxes for holding ashes. But a metal box of the right size cannot always be readily found. Why not make a box just the size and shape that is needed?

Materials Needed:

One piece of sheet metal large anough for the complete box, and at least four soft iron rivets. The box shown here requires four rivets. Boxes with higher sides require more. Generally 8-ounce rivets are used for light weight sheet metal, but common nails may be cut to the proper length for rivets.

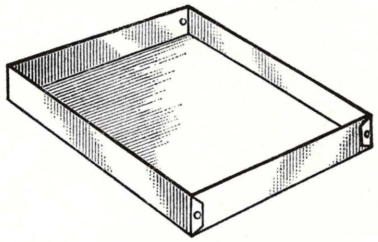


Fig. 117—A box made of metal

Equipment Required:

A pair of tinner's snips, a scratch awl, a rule, a solid punch, and a rivet set, riveting hammer, and a block to lay the metal on while bending.

Here Is a Plan for Making a Box 1″×5″×5″. If a different size is desired, the dimensions on the layout must be changed.

1. Lay out the design on the sheet metal with the rule, square, and scratch awl. Particular care must be taken that all lines be drawn correctly. The bottom should be square or rectangular.

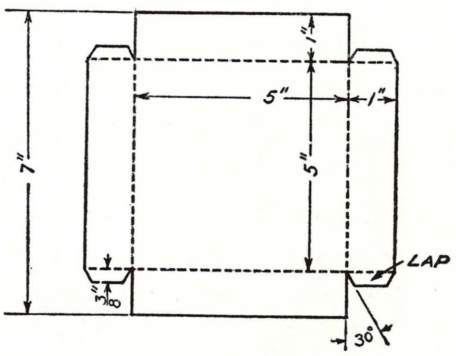


Fig. 118—Working drawing of the box

2. Cut out the design with tinner's snips. Be very careful to cut exactly on the lines drawn. Once an error has been made in the cutting, it cannot be corrected.
3. Brake the metal on the bottom lines on all four sides. Sheet metal shops have a machine to do this, but at home simpler means have to be devised. Here is a plan that works very well for small boxes.

Caution: Do not use a hammer because it stretches the metal.

(*a*) Cut a wood block the same size as the bottom of the box and clamp the metal to the block.

(*b*) Brake the metal on the lines over the wood block, using another block of wood to bend the metal. (See Fig. 119.)

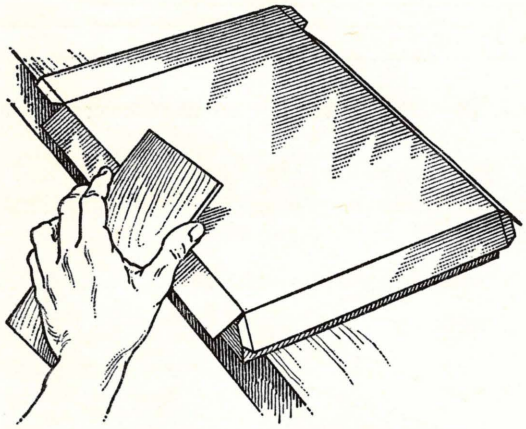


Fig. 119—Brake the corners for the metal box over a block

If the box is to be quite large, the metal may be broken over the edge of a bench, or clamped between two boards and broken with another piece of wood.

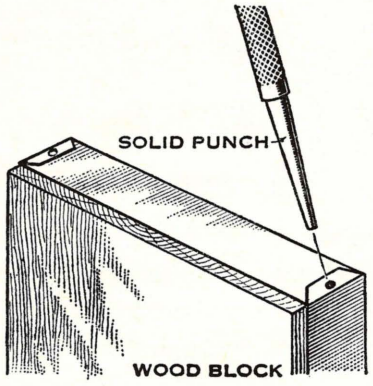


Fig. 120—Punching the holes for riveting the corners of the box

4. Punch holes for rivets in the center of each lap. The box should be placed over the end grain of a piece of hard wood while the holes are being punched. Never try to punch a hole through metal while it is lying on an anvil because the end of the punch will be spoiled. (See Fig. 120.)
5. Rivet the corners. In making small boxes, the head of the rivet may be placed on the inside of the box. The head of the rivet must rest on a metal block while the riveting is being done. (See Fig. 115.)

   Note: If the box is expected to hold water, the corners will have to be soldered.
6. Finish the box. Not much finishing is necessary. Sharp corners should be filed down, and the entire surface may need cleaning. Be extremely careful not to scratch the metal. If tin or zinc plating is scratched, the metal is likely to rust.

Now That You Have Finished the Box, Do You Think You Have Learned Anything About Sheet Metal?

1. Does the box have any dents or scratches?
2. Are the rivets neatly set?
3. Does the box remain level?
4. Do you know why the rivet holes are punched instead of drilled?
5. Why not use a hammer to brake the metal?

JOB NO. 29

HOW TO MAKE A COOKIE PAN

Does a boy like cookies? The amount of enthusiasm shown on baking day is enough evidence to answer the question. Here is a plan for making a cookie pan which enables one to remove the cookies much more easily than from the ordinary pan. It may prove to be a special inducement for mother to make an extra batch of cookies.

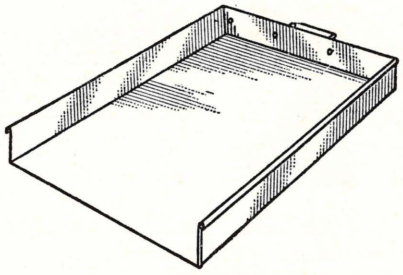


Fig. 121—The cookie pan

Necessary Materials:

A piece of sheet metal $13\frac{5}{8}'' \times 17\frac{5}{16}''$. Either tin plate or ordinary black iron is suitable. Four 8-ounce rivets are necessary.

Necessary Equipment:

A rule will be necessary to lay out the design. It will have to be at least 18″ long. A scratch awl, solid punch, rivet set, tinner's snips, and wood for bending are also necessary.

Here Is a Plan for Making the Cookie Pan. It will be well to follow instructions carefully, for this is a difficult job.

1. Lay out the design of the cookie pan on the metal. Be sure that all corners are square, or it will not fit together well.
2. Cut out the design with the tinner's snips.

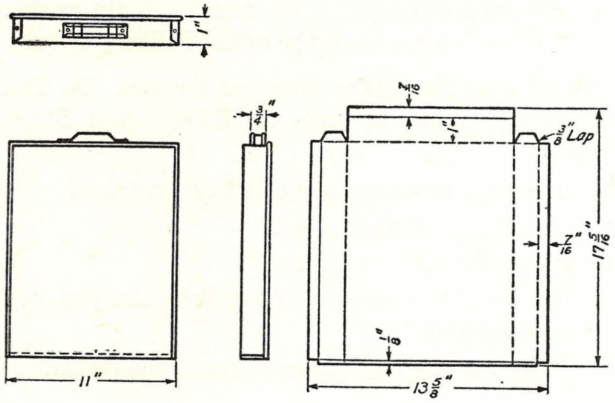


Fig. 122—The working drawing for a cookie pan

3. Fold the hems on the edges. In order to fold the hems, the metal should be clamped between two straight pieces of wood. Then clamp the hem between two pieces of wood to flatten it.

   Note: The sides and the back have a double hem, while the front has a single hem.

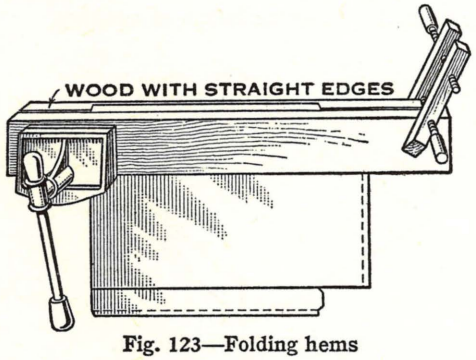


Fig. 123—Folding hems

4. Brake the metal on the corners over the edge of a bench or table. (See Fig. 119.)
5. Rivet the corners. (See Fig. 120.)
6. Lay out the handle. The layout must be accurate, or the handle will not be the right size.
7. Cut out the handle with the tin snips.
8. Shape the handle. Hems are put on things made of sheet metal to give them strength, and to get rid of sharp edges.
9. Rivet the handle in place.
10. Smooth any rough edges with a file.

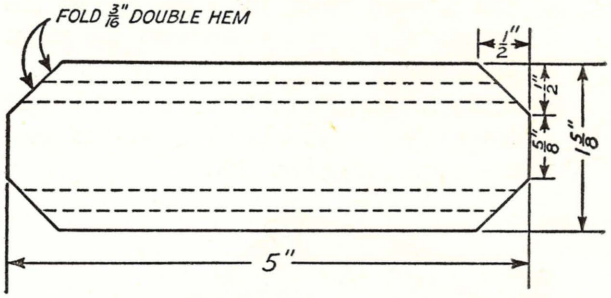


Fig. 124—The layout for the handle of the cookie pan

Is the Completed Job Good Enough to Take Home to Mother? Here are some questions to answer.

1. Are all of the sides the same height?
2. Does the pan lie flat?

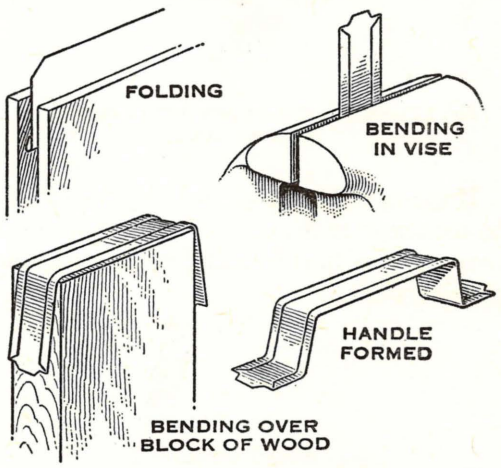


Fig. 125—Forming the handle

3. Are the hems neatly made?
4. Why are hems used in sheet metal work?
5. What are ordinary tinners rivets made of?
6. Why are joints riveted instead of soldered?

JOB NO. 30

HOW TO MAKE A COOKIE CUTTER

Somehow, cookies made into fancy shapes seem to taste better than others. It is a simple matter, with a few simple tools and some sheet tin plate, to make almost any shaped cutter.

Materials Necessary:

One piece of tin plate $\frac{3}{4}$" wide, and long enough to form the shape desired, allowing for a $\frac{1}{4}$-inch lap.

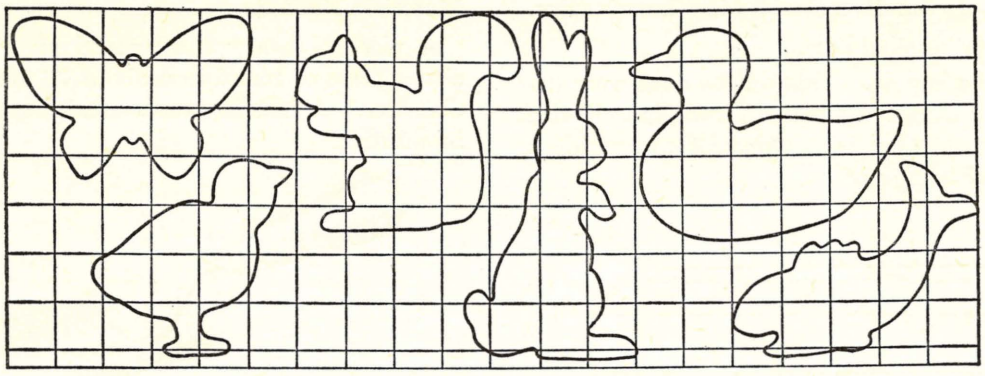


Fig. 126—Cookie cutters may be made in many shapes

One piece of tin plate for the top, and another for the handle.

Equipment Necessary:

Soldering equipment, tinner's shears, scratch awl, and rule.

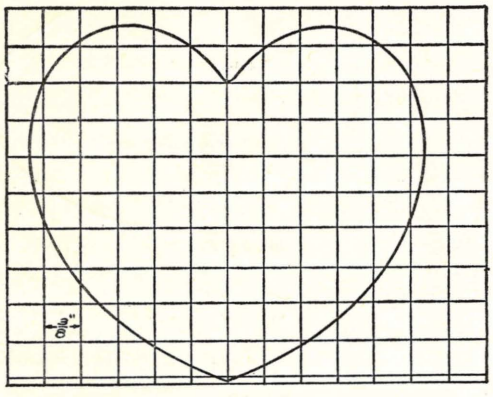


Fig. 127—Pattern for a heart-shaped cookie cutter

Here Is a Plan for Making a Heart Shaped Cookie Cutter. Other shapes are made exactly the same except for the shaping.

1. Make a full sized drawing for the shape of the cutter desired. The top should be about the same shape but larger all the way around than the cutter.
2. Shape the sides of the cutter. Use an iron pipe, a rod, or a piece of sheet metal clamped in a vise on which to bend the metal. Most of the bending can be done with the hands.
3. Solder the ends together, forming a lap joint, with $\frac{1}{4}''$ lap. Care should be taken that a good joint is made. Otherwise, dirt will get in and make the cutter unsanitary. (See Fig. 103.)
4. Punch a $\frac{1}{2}''$ hole in the center of the top.
5. Solder the top to the cutter. First, tack the cutter to the top with solder in several places. Then run the solder all of the way around with the soldering copper.
6. Trim the top to shape with the tinner's shears.

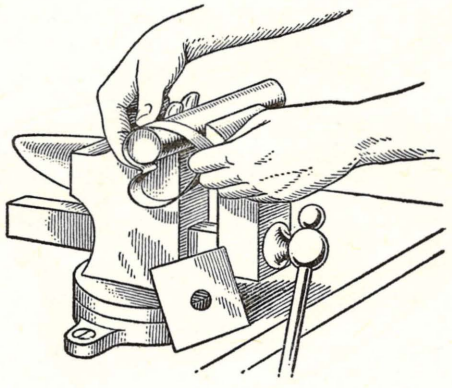


Fig. 128—Shaping the cookie cutter

7. Lay out the design for the handle. The length of the metal should be about $1\frac{1}{2}$ times the distance between the two places where it is to be fastened to the top. (See Fig. 130.)

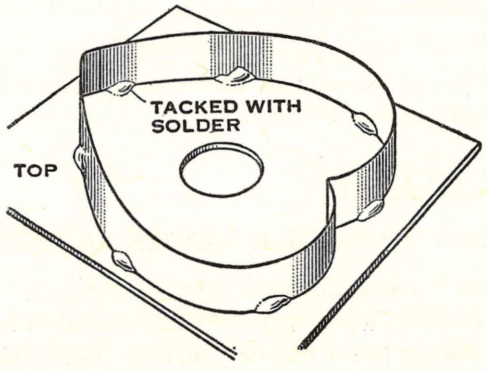


Fig. 129—Tacking the blade to the top

8. Cut out the handle material with tinner's snips.
9. Fold a $\frac{3}{16}$" double hem.
10. Shape the handle. This can be done over the head of a mallet or a piece of iron pipe. Notice that the ends are bent outwards to provide a better soldering surface.

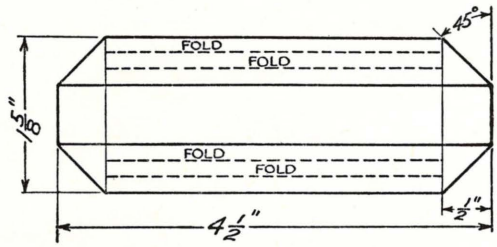


Fig. 130—Working drawing for the handle

11. Solder the handle in place. Be sure to wipe off surplus flux with a piece of cloth. This prevents rusting.

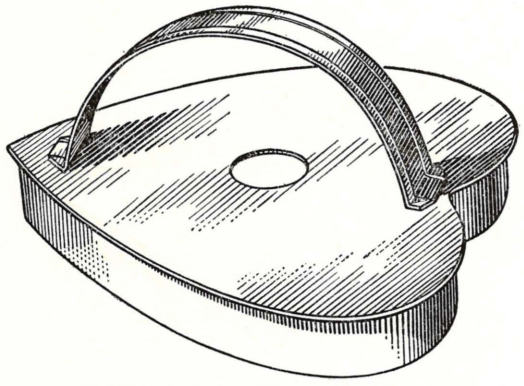


Fig. 131—Solder the handle in place

Have You Done a Good Job? These questions may help you decide.

1. Are the sides and handle neatly soldered in place?
2. Are the sides well shaped?
3. Are there any open cracks for dirt to enter?
4. What is meant by tack soldering?
5. Why are the ends of the handle bent outwards at an angle of 90 degrees?

JOB NO. 31

HOW TO MAKE A GARDEN TROWEL

When working about the garden or window box, a small trowel will always be found useful to loosen the earth, or to set out new plants. It is a simple matter to make one.

Materials Needed:

A piece of heavy sheet metal about $\frac{1}{16}$" thick, also a piece of round iron about 7" long and $\frac{1}{4}$" in diameter. A handle can be made from a piece of broomstick.

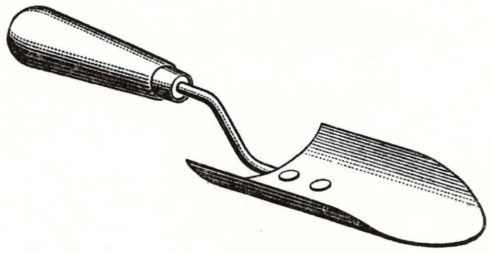


Fig. 132—The garden trowel

Equipment Needed:

The regular sheet metal tools, especially the file, cold chisel, hack saw, hammer, drill, rivet set and center punch.

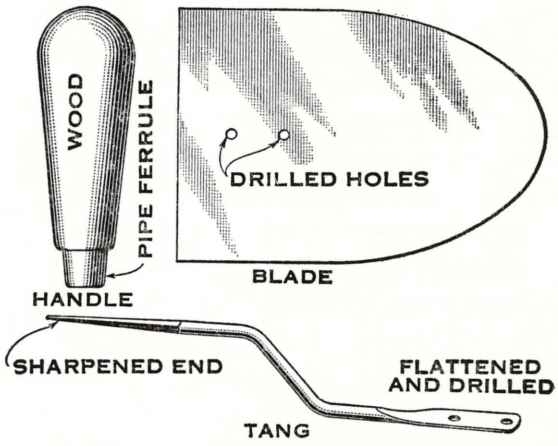


Fig. 133—The parts of a garden trowel

Here Is a Plan for Making a Garden Trowel.

1. Make a cardboard template for the blade of the trowel. Be sure to fold the paper and cut both sides at once so as to get them the same.
2. Transfer the design to the metal and cut out the blade. It may be necessary to use the hack saw or cold chisel if the metal is too heavy to cut with the tinner's snips.
3. Smooth the ragged edges with a file.
4. Drill holes for attaching the blade. Be sure that they are in the center, and are not too far apart.
5. Shape the blade over the head of a mallet or a round piece of iron.
6. Shape the iron bar for the tang. One end should be flattened with a hammer. The tang may

be bent to shape by placing the bar in a vise and bending it by hand. The other end should be hammered square and pointed to receive the wood handle.

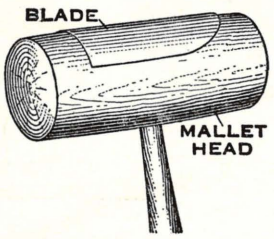


Fig. 134—Curving the blade over a mallet head

7. Mark and drill holes for the rivets. In marking these holes, the bar should be held in place on the blade, and the holes marked with a pencil. Then the holes should be centered with a center punch for drilling.
8. Rivet the handle in place.
9. Make the wood part of the handle from an old broom stick.

Now That You Have Completed the Trowel, Do You Think You Have Done a Good Job? These questions may help you decide.

1. Is the handle in the center?
2. Is the handle riveted tightly to the blade?
3. Have the edges of the blade been sharpened?
4. What tool is used to center holes to be drilled?
5. Why not punch the holes through the handle?

METHODS OF FASTENING WIRE

Repairs with wire can be more successfully made if proper methods are used in fastening the wires. These suggestions are given here to be considered in doing repair or construction work.

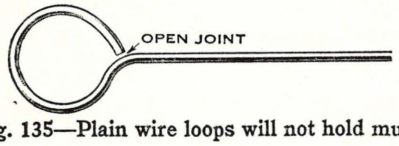


Fig. 135—Plain wire loops will not hold much

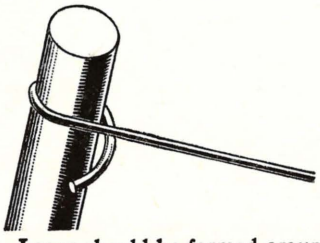


Fig. 136—Loops should be formed around a rod the size desired

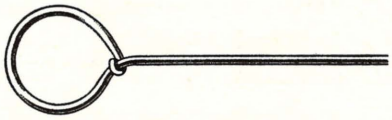


Fig. 137—Loop with end hooked around the main stem is stronger

MAKING WIRE LOOPS

There are many different kinds of loops, because of their variety of uses.

A handy way to make a small loop is to wind the wire around a rod the size of the loop desired.

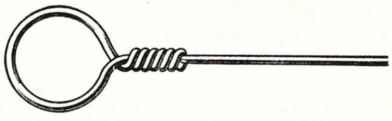


Fig. 138—Loop with end wrapped several times around the main stem, is quite strong

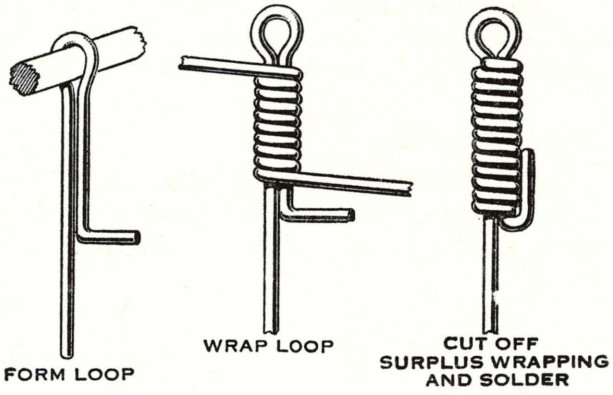


Fig. 139—The strongest loop is the one used on airplane construction. The loop end is wrapped with a second wire and soldered

MAKING SPLICES

Splices are also made according to the purpose for which they are intended. Here are the important ones.

Fig. 140—A soldered butt splice is used when a small smooth joint is desired

Fig. 141—The Western Union splice is used for electrical construction

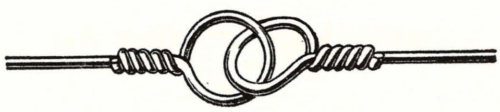


Fig. 142—The loop splice gives a flexible joint

JOB NO. 32

HOW TO MAKE A SCREEN DOOR HOOK

Often a hook is needed for a screen door or window when it is not convenient to purchase one from the hardware store. One can be made quickly and easily from a piece of wire.

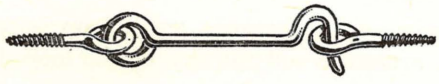


Fig. 143—Screen door hook with screw eyes ready to be attached to the screen door

Materials Needed:

A piece of wire about 8″ or 10″ long for the hook, and two staples or screw eyes for attaching and fastening the hook. Stiff wire makes the best hook, but of course it is more difficult to form. The larger the hook, the heavier the wire should be.

Equipment Needed:

Usually a pair of wire cutting pliers and a hammer are enough. However, a vise and a small iron rod for shaping the hook will be found useful.

Here Is a Plan for Making the Hook.

1. Bend the hook to shape. Use a piece of wire much longer than actually needed for the hook, in order to have the ends for bending.

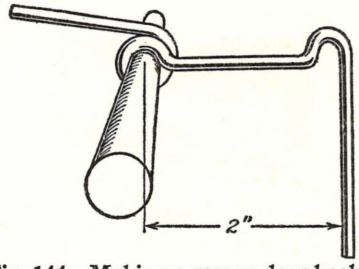


Fig. 144—Making a screen door hook

2. Drill pilot holes in the door and door frame for attaching. If staples are used instead of screw eyes, this is not necessary.

Have You Made a Good Hook? These questions may help you decide.

1. Is the hook scarred by tool marks?
2. Does the hook work well?
3. Is the hook well shaped?
4. Is No. 10 wire larger or smaller than No. 12 wire?
5. Can galvanized wire be soldered?

Painting and Finishing in the Home

Chapter 3

THE household mechanic is often called upon to do some form of painting or finishing around the home. The jobs vary from painting the house to varnishing a wall shelf or painting a coaster wagon. They include the finishing of wood, metal, cement and plaster. In order to be able to do these jobs, there is much for the household mechanic to learn about the different kinds of finishes, and the materials and equipment necessary to do them. The following instructions are intended to give the household mechanic enough information so that he will be able to do the ordinary job of finishing.

REASONS FOR FINISHING

Finishes are applied to materials for at least three reasons. The first, is decoration. A house would have a very drab appearance if no paint or stain were used to give it color. Furniture is much more attractive when finished with paint, stain, varnish or lacquer. A beautiful piece of wood, when properly finished, is a work of art. The second reason is preservation. Many years are added to the life of either wood or metal by the use of finishes. Wood rots, swells, and warps when exposed to the weather. Metal rusts or tarnishes when exposed to the air. The third reason is sanitation. Furniture and woodwork are much easier to keep clean if sealed with paint or varnish. Dirt and grease cannot get down into the pores of the wood. Dirt is much easier to see on a painted surface, and it comes off more easily when washed.

PAINT FINISHES

Paint is called an opaque finish because it completely covers the surface. The color or grain of the surface to which it is applied does not show through. For this reason, paint is usually applied to surfaces which are not attractive in themselves, or where color is desired. Paint is the most widely used of any of the finishes, being applied to wood, metal, cement or plaster. It can be used with reasonable success by the household mechanic.

It is safe to say that paint, in general, is made of pigments, such as white lead, and zinc white, and vehicles, such as linseed oil, turpentine, and in some cases, color pigment and drier. This is not strictly true for all paints, but true enough for general purposes. The household mechanic should buy his paint already mixed anyway. Modern paint chemists have found it necessary to find substitutes for many of the materials formerly used. There are so many different kinds of paint that each one will be discussed separately.

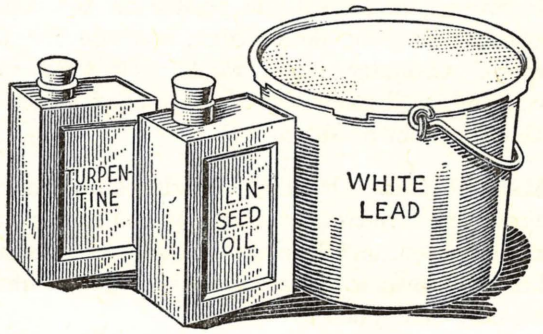


Fig. 145—The principal materials in outside paint

OUTSIDE PAINT

Outside paint is used on buildings, lattice work, fences, garden benches, and numerous other articles which are exposed to the weather all seasons of the year. The action of the sun, rain, wind, ice, and the collection of dirt soon causes decay. Wood which is not protected presents a very drab appearance. Metal which is not protected soon rusts away, and has to be replaced. Outside paint should not be used indoors because it takes too long to dry. It needs exposure to the sun and wind for drying.

White paint contains mostly white lead, zinc white, and linseed oil. The white lead and zinc white are the pigments which give the paint its color, and the linseed oil is the vehicle which makes it possible to spread the pigment over the surface in an even coat. When dry, these materials provide excellent protection from the weather. Other light shades of paint, such as ivory, cream and buff, use white lead for the pigment, but have other colored pigments added. Red paint contains red

lead instead of white lead, or it may be colored with mineral pigments. Blue, green, and black paints have various other kinds of pigments instead of white lead. Varying amounts of thinner are added to outside paint to make it penetrate the wood, and to make it spread easier. Turpentine is the best thinner. Other materials are sometimes used because they are cheaper. Drier is seldom necessary in outside paint, although in cold and damp weather it is sometimes used. The household mechanic should avoid using drier, however, because it has a tendency to break down the lasting qualities of the paint.

Porch and Deck Paint. An especially good paint is needed to stand the wear on a porch floor, or to waterproof a canvas deck so that the water will not leak through and spoil the plaster on the ceiling below. Porch and deck paint is made for this purpose. Ordinary paint would not wear well. Porch and deck paint should be applied according to the directions on the can.

Metal Primer. Ordinary outside paint does not stick well to eave troughs, flashings and rain spouts. For this reason, metal primer is used. It is usually red or gray in color. After it is dry, regular outside paint may be applied over it.

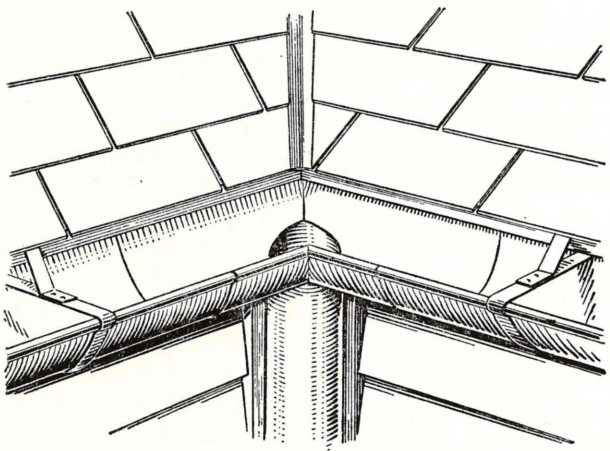


Fig. 146—Eave troughs should be painted with metal primer before regular outside paint is applied

SEALERS AND CRACK FILLERS

Shellac is used in outside painting for covering knots and pitchy spots in wood. This is done to prevent the pitch from oozing out of the wood and raising the paint, or from "bleeding" through the paint, causing brown spots. Alcohol is used to thin shellac.

Aluminum paint is often used as a sealer for knots and pitchy spots in wood. Some painters recommend it for the entire priming coat. It will stick to metal as well as wood. The most common use of aluminum paint is for radiators, heat pipes and water pipes. When shingle stain runs down over the side of a house it often bleeds through paint which is applied over it. If it is first given a coat of aluminum paint, the stain will be sealed in, and will not come through.

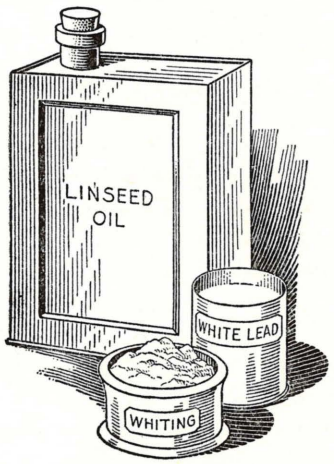


Fig. 147—The materials used in making white lead putty

Putty is used for filling nail holes and small cracks in wood after the priming coat has been applied. In painting, a white lead putty should be used. It is made by mixing whiting with white lead and a little linseed oil until it can be handled without sticking to the hands. Ordinary putty may be used, but white lead putty will stick in the cracks and holes better. Putty is often colored to match stained woods so that it does not show when used for filling nail holes. Probably the best putty to use for filling cracks and nail holes while painting, is to take some of the material which has settled to the bottom of the can of paint being used, and mix it with whiting. See Mixing Putty, page 171.

PAINT THINNERS

Linseed oil is really a vehicle for the lead and color in paint instead of a thinner. However, it is used to thin outside paint for the first, or priming coat. Linseed oil is made from flax seed. It comes in two forms, raw and boiled. Boiled linseed oil is generally used because it dries faster than raw linseed oil.

Turpentine is a thinner for both inside and outside paints. It has a tendency to cause paint to dry faster, and to have a dull finish when dry. Turpentine is made from pine trees which grow in the southern part of the United States.

Turps, Synthetic Turpentine, or Oleum Spirits. These are all names for a mineral oil substitute for turpentine. It is cheaper than real turpentine, and quite widely used.

INSIDE PAINT

Inside paint is a name which may apply to any one of a large number of paints, all of which should be used indoors. They will not stand exposure to the weather, but they will stand ordinary indoor wear. They are used to improve appearance, and to aid in sanitation. Inside paints contain more turpentine and drier than outside paints. The household mechanic should be familiar with the following varieties of outside paint.

Flat paint is used wherever a dull finish is desired. It may be used on either wood or metal. It is often used as an undercoating for enamel.

Enamel Undercoating and Enamel. These two varieties of inside paint are discussed together because they are used together. It is necessary to explain both in order to explain either one.

Enamel undercoating is the base paint over which enamel is applied. It contains a large amount of pigment, and, when thinned with turpentine, penetrates the pores of the wood. It makes an excellent base for enamel. Enamel does not stick well to a glossy surface. Enamel undercoating dries with a dull finish, therefore enamel sticks well to it. Sometimes it is desirable to apply a second coat of enamel undercoating, in order to get a better finish. Roughness, dust particles or specks should be removed with sandpaper before applying the enamel.

Enamel is made of pigments with varnish as a vehicle. Therefore, it is more or less transparent. Enamel undercoating of the same color should always be used first. Two coats or more of undercoating are usually required on new work. The first, or priming coat is thinned with turpentine to make it penetrate. On old work of the same color, enamel may be applied without undercoating if the surface is in good condition, and has had the gloss removed with sandpaper. If the surface is checked, peeled, or has been worn off in spots, at least one coat of undercoating should be used. When the color is being changed, at least one coat of undercoating should be used. Otherwise, the old color may show through the enamel, and two coats of enamel will have to be used to cover the old. Undercoating is much cheaper than enamel, and if each coat is sanded down a much superior finish will be obtained.

Enamel is a very popular finish for furniture and inside woodwork because it dries with a very attractive finish that wears well. It may be purchased in either dull, semi-gloss, or glossy finish. Enamel has one disadvantage for the household mechanic. It is difficult to apply. Unless mixed and applied properly with a good brush it is apt to run or sag. Whenever possible, an article should be laid flat to dry after being enameled.

Wall paint is an inside paint made especially for use on plastered walls. It is usually made in pastel tints or shades, and in flat, semi-gloss, or glossy finish.

Wall Sizing must be applied to newly plastered walls before painting. This is to prevent the plaster from absorbing all of the oil from the paint. Wall sizing is made principally of glue. It comes in the form of a powder, and must be dissolved in warm water before applying. Thin varnish, or thin shellac, is sometimes used instead of the glue sizing.

Oil Pigments (Colors Ground In Oil). It is often impossible to buy paint the exact shade desired. Colors ground in oil may be purchased to change the shade or color. It is sold in tubes or in cans, in the form of a paste, and should be thinned with oil and turpentine before mixing with paint. Do not confuse colors in oil with Japan Colors. Japan Colors are used by sign painters, and dry too fast for ordinary painting. See Job No. 35.

Kalsomine has long been used for decorating walls and ceilings. It is a powder which is mixed with water, and applied the same as paint. It is sold in a number of attractive shades. Kalsomine is very easy to apply, and dries in a few hours. It is not waterproof, however, and cannot be washed. Before a new coat is applied, the old coat must be washed off.

Water-Mixed Paints. During the past few years, several very excellent water-mixed paints have been developed. They have, to a great extent, taken the place of kalsomine and are being used in place of wall paper. They may be applied to plastered walls, or directly over wall paper. They are excellent

for basement walls where ordinary paint often refuses to stick. The advertised drying time is as low as forty minutes, but to be safe, it is well to allow more time. After thirty days some good grades are washable. These water-mixed paints are sold in a variety of attractive shades. They are easy to apply, and dry with a flat, eggshell finish.

One variety of these water-mixed paints is called casein paint, and is made of milk. Another is called resin paint.

Fig. 148—Casein or resin paints may be applied directly over wall paper

Cement Floor Paint. It is usually very difficult to get a covering for a basement floor that will stick. The cement is usually too damp for ordinary floor paints. There are several products on the market made especially for basement floors. Some are cement dyes, and some contain rubber. The best plan is usually to inquire among the neighbors and find one who has had good success with a particular kind. Special directions for applying will come with each brand. In no case should one attempt to paint a cement floor that is apt to be flooded with water.

SANDPAPER

Sandpaper is the most common abrasive material used in finishing. It is made of crushed stone which has been glued to paper, and is sold in a number of grades of fineness. The household mechanic needs to be concerned only with grades between No. $1\frac{1}{2}$, which is coarse, and No. 7/0, which is very fine. Most hardware stores sell sandpaper in sheets, or in convenient size packages for home use.

Other common coated abrasive paper materials which may be used in place of sandpaper are garnet paper, silicon-carbide paper, and aluminum-oxide paper.

EMERY CLOTH

Emery cloth is an abrasive commonly used on metal. It is used because the abrasive has to be very sharp and hard to cut metal, and because the cloth to which the abrasive is glued is stronger than paper. It may also be obtained in many grades of fineness, ranging from No. 3, which is coarse, to No. 3/0, which is fine.

FACTS CONCERNING MATERIALS AND EQUIPMENT

BUYING PAINTS AND VARNISHES

Most people buy ready mixed paints and varnishes in sealed cans. This is convenient, and usually the cheapest for small jobs. Paints and varnishes may be purchased in a wide range of prices. The price however, is not a guarantee of the quality. Some standard brand with a known reputation is the safest to use. Cheap material is apt to be the most expensive in the long run because it does not give long service.

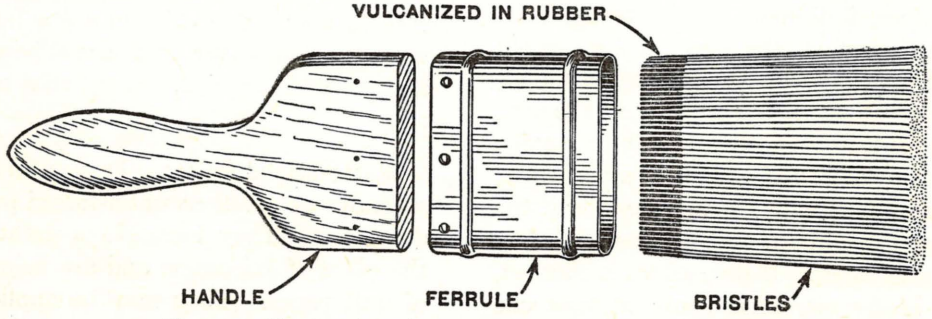


Fig. 149—The brush is the most important tool of the painter

EQUIPMENT NEEDED AND HOW TO CARE FOR IT

The Paint Brush

A good brush is one of the first requirements of a painter. The size of the brush depends upon the kind of work to be done. Brushes may be purchased in sizes varying from the small pencil brush up to the siding brush four or five inches wide. They vary in price from a few cents up to several dollars. A good brush is the cheapest in the end. If properly cared for, it will last long enough to pay for several cheap brushes. Some workmen do good work with a wide brush. Another worker will get along better with a narrow brush. It takes an expert to use a large brush efficiently.

At least two sizes of brushes are needed for painting the outside of a house. If wood siding is to be painted, a four- or five-inch siding brush should be purchased. The better grade of siding brushes have long bristles so that they will hold a lot of paint. Recently, the more expensive brushes have bristles

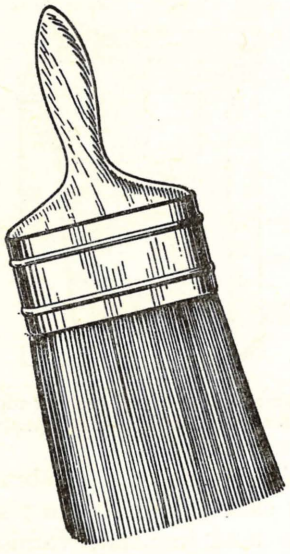
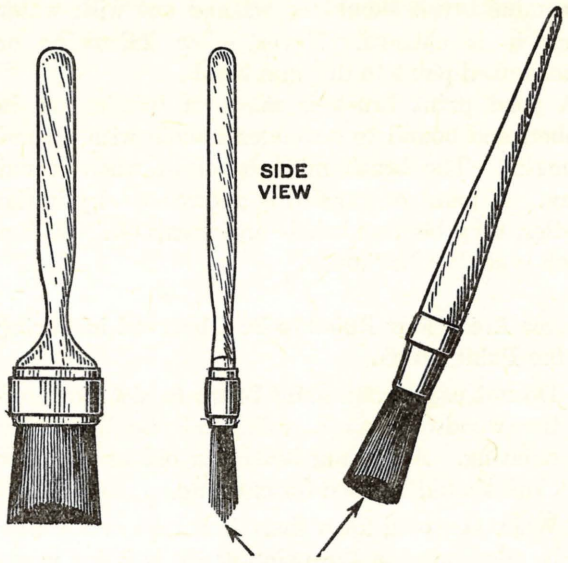


Fig. 150—Siding brush

made of nylon. A sash brush, or sash tool, will be needed for tracing, or cutting in, the sash. The bristles on regular sash brushes are trimmed to a chisel point. This enables the painter to run the paint onto the glass in a fine even line which does not have to be wiped. The sash brush may be purchased in either the round or the flat type.

A Brush For Enameling. To the ordinary observer, there isn't much difference between an enameling brush, and any other brush. There is a difference, however, which is very important to the



Figs. 151-152—Flat sash brush

Fig. 153—Round sash brush with chisel point

user. When enamel is applied, it becomes sticky, or tacky. A brush must be used which has enough body to level it off, instead of just sliding over the top. The enameling brush has more bristles than the ordinary brush, and they should be trimmed to a chisel edge like sash brushes. One reason people have trouble with enamel sagging is that the brush they use is too thin, and does not spread the enamel evenly enough.

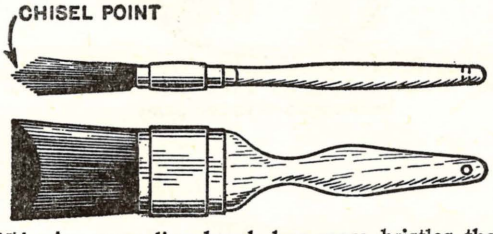


Fig. 154—An enameling brush has more bristles than the ordinary paint brush

The kalsomine brush is much wider than the ordinary paint brush, usually being from six to ten inches wide. It is made in the same way. The

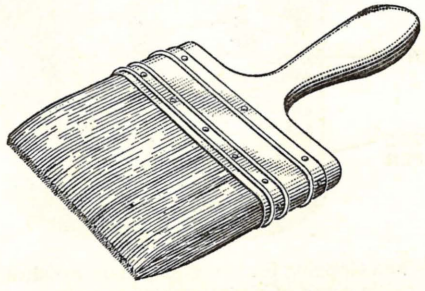


Fig. 155—A kalsomine brush

kalsomine brush should be washed out with water when it is cleaned. Never allow kalsomine or water-mixed paint to dry in a brush.

A good paint brush is made of bristles set in rubber, and bound to a wooden handle with a band of metal. The brush must be clean when stored away. If paint or varnish is allowed to dry in the bristles, they become brittle and break off. Such a brush is said to be "lousy."

Here Are a Few Rules to be Observed in Caring for the Paint Brush.

1. Do not use a good paint brush to clean or dust the woodwork as it will spoil the brush for painting. A dusting brush, an old brush, or a cloth should be used for cleaning.
2 When stopping for a short time, the brush may be suspended in the paint which is being used. It should be suspended on a hook attached to the side of the can. A hole may be bored in the handle of the brush for this purpose. The brush should never be allowed to remain in the paint resting on the bristles.
3. When stopping for overnight, or between coats, the brush should be dipped into the paint so that the bristles are well filled with paint. Then wrap the bristles and ferrule with paper, and set the brush in a can of water. Be sure that the water comes up at least half way on the ferrule. In this way, air cannot get to the paint, and it will not dry. When you are ready to paint again, shake the water out of the brush, and start painting.
4. When stopping for several days or weeks the brush should be suspended in a mixture of turpentine and linseed oil. This keeps the bristles from becoming hard. The brush should be wiped clean before it is used again. Shellac or lacquer brushes should be cleaned immediately. (See Fig. 158.)

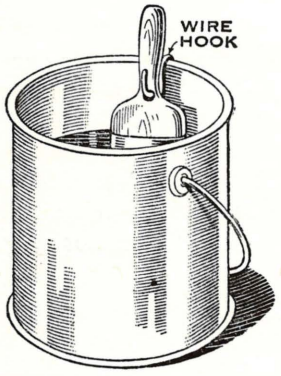


Fig. 156—When stopping for a few minutes, the brush may be suspended in the paint

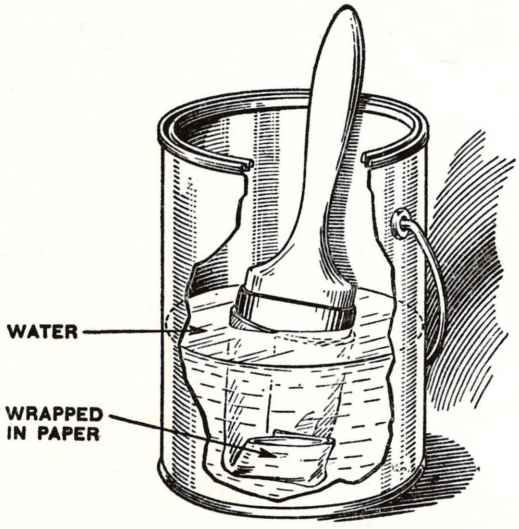


Fig. 157—When stopping for overnight, paint brushes may be set in a can of water without cleaning

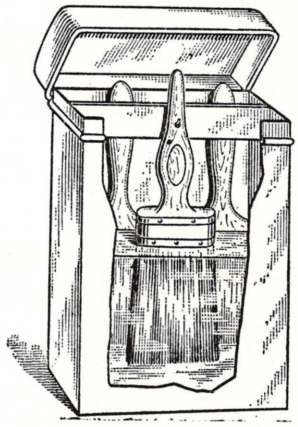


Fig. 158—When stopping for a week or more, suspend brushes in linseed oil and turpentine

4. When the job is finished. The brush should be thoroughly cleaned. Here is a plan for caring for brushes used in paint, varnish, stain, or filler.
   (*a*) Wash out all paint with turpentine, gasoline, kerosene or benzine.

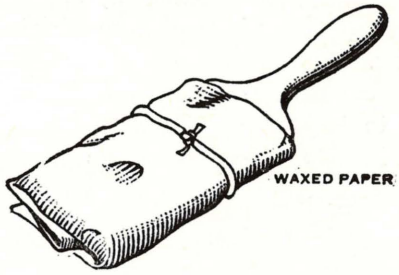


Fig. 159—A paint brush wrapped for storing

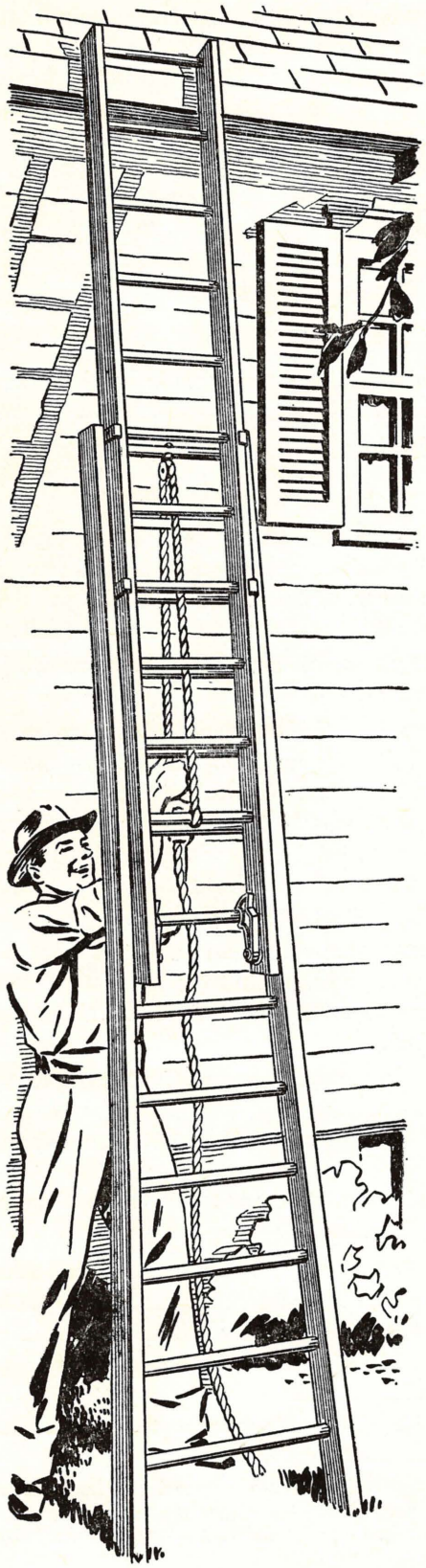


Fig. 160—Extension ladder

(*b*) Work out all the oil on a rag or a piece of wood.

(*c*) Wash clean with soap and warm water. Dry thoroughly.

(*d*) Wrap in waxed paper, and lay away in a dry place. (See Fig. 159.)

(*e*) Lacquer brushes must be cleaned in lacquer solvent.

(*f*) Shellac brushes should be cleaned in alcohol.

5. When changing the color of paint, the brush must be cleaned thoroughly.

6. A general rule for cleaning all brushes. A brush should be cleaned in the same liquid as is being used to thin the material in which the brush is used.

Ladders. Two ladders are necessary for painting most houses. An extension ladder at least 24 feet long will be needed for reaching the high places. It can be taken apart and the halves used separately for places which are too high for the step ladder. A six-foot step ladder is needed for places which are too high to reach from the ground. It is very dangerous to use a weak or broken ladder, or boxes and chairs piled on tables. A good ladder should be

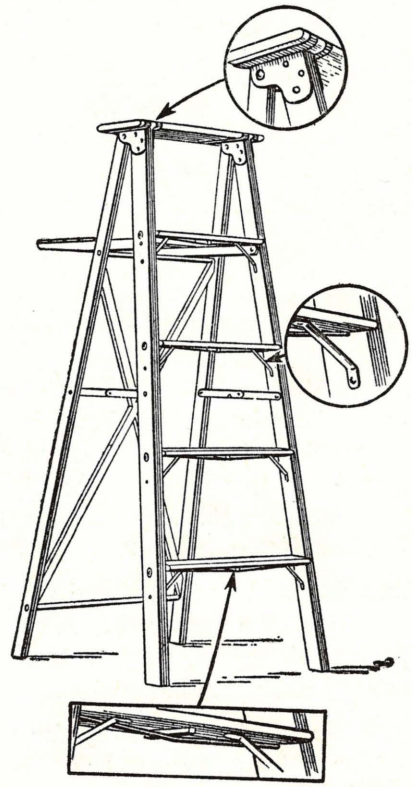


Fig. 161—A step ladder and an extension ladder are needed for painting most houses

used. Always be sure that the ladder is resting on level ground, and is leaning against something solid.

Safety Measure: The bottom of a ladder should be set away from the building a distance equal to one-fourth the length of the ladder.

A Wire Brush is used for removing paint scales and other material from the surface in outside painting.

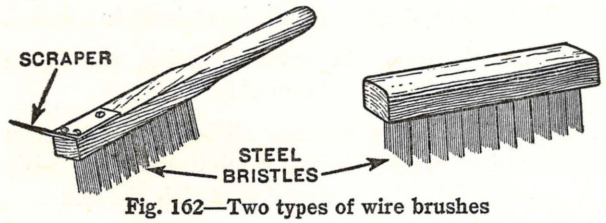


Fig. 162—Two types of wire brushes

A Wire Hook is necessary for fastening the pail if one has to work standing on a ladder. This leaves one hand free to use in holding to the ladder.

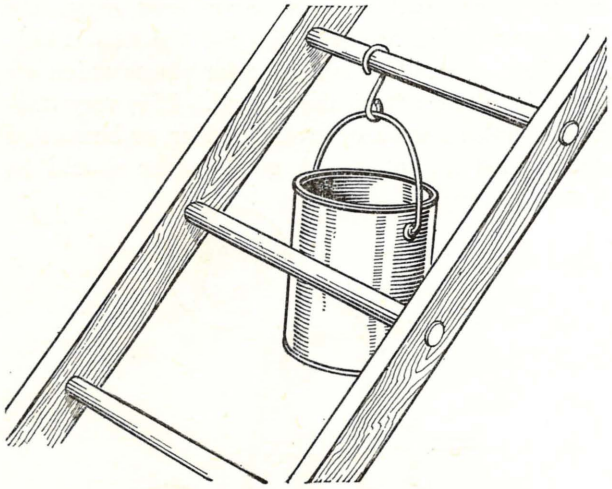


Fig. 163—A hook for holding the paint pail leaves one hand free to hold on to the ladder

A Paint Can With a Bail will be needed to dip the brush in while painting. It should be of a size which is convenient to use. It should be large enough to allow plenty of room for dipping the brush without touching the edges. The can should never be filled more than half full.

A Dusting Brush or rag is needed for brushing the dust or dirt off the woodwork. A cheap paint brush kept for this special purpose is very good. Special dusting brushes can be purchased.

A Putty Knife is often necessary for removing old paint or dirt which happens to be on the surface. It is also needed for filling nail holes or cracks with putty.

A rag is necessary for cleaning surplus paint or varnish from places where it has been accidentally smeared or dropped. It is also useful for cleaning the handle of the brush, or the outside of the paint can. One should be able to paint without getting the handle dirty, but the amateur is very likely to allow the paint to drip from the brush. The rag used for wiping paint should not be allowed to lie around as it is likely to start a fire. All oily rags should be burned immediately.

How to Store Paint

Household mechanics usually have a mixture of odds and ends of paint on hand, left over from previous jobs. These usually dry up and have to be thrown away. Here are some useful suggestions for saving them to use on the next job.

1. Paint dries up when it comes in contact with the air. Therefore, it should be put in an air-tight container, small enough that the paint fills the container. No air space should be left.
2. Seal the container. Glass mayonnaise jars are excellent.
3. You will notice that paint which has been on the shelf for a long time tends to separate. The pigment settles to the bottom. Cans and jars of paint should be turned upside down every few months. This will prevent the pigment from becoming too hard.
4. Paint which has been opened for some time forms a skin over the top. Pour a little linseed oil over the skin, and the paint underneath will stay soft for a long time if the skin is not disturbed.
5. The skin which forms on the top of paint should be removed before the paint is used. It will not dissolve if stirred up with the paint.

The Following Questions Will Test Your Knowledge of Paints

1. Outside paint contains mostly _____ and _____.
2. Turpentine is used as a _____ for outside paint.
3. The first coat of paint is called the _____ coat.
4. What kind of paint should be used for the first coat on metal?_____.
5. Outside paint needs exposure to the _____ and _____ for drying.
6. What paint is often used as a sealer for knots _____?
7. The material which settles to the bottom of a can of paint makes good putty for filling cracks when mixed with _____.
8. Linseed oil is mixed with _____ for the first and second coats.

9. Paint brushes may be cleaned with 1. _____, 2. _____ or 3. _____.
10. When stopping painting for overnight, paint brushes may be wrapped in paper and set in _____.
11. Shellac is thinned with _____.
12. Loose paint may be removed with a putty knife or a _____ brush.
13. Paint dries up when it comes in contact with the _____.
14. Would inside paint dry if used outdoors?
15. What kind of paint should be used before enamel?
16. If two coats of enamel are used, the finish of the first coat must be _____ with _____ before applying the second coat.
17. What kind of paint would you recommend for a kitchen table?_____.
18. What kind of paint would you recommend for the walls of a bedroom?_____.
19. What kind of paint would you recommend for the walls of the basement recreation room?_____
20. No. 7/0 sandpaper is a _____ grade.

JOB NO. 33

HOW TO MIX A CAN OF PAINT

People sometimes fail to get good results because the paint was not well mixed. The paint is thin on top, and by the time they get to the bottom of the can there is nothing there but a thick paste. It is not difficult to mix paint properly.

Materials and Equipment Necessary

Ready-mixed paint usually requires no thinning except for the priming coat, when turpentine may be necessary. You should also have a clean can as large as the paint can, a paint paddle, and a screwdriver for opening the can. A good painter uses a lot of time stirring the paint.

Here Is a Plan for Doing the Job. Follow closely figures 164 to 170 inclusive.

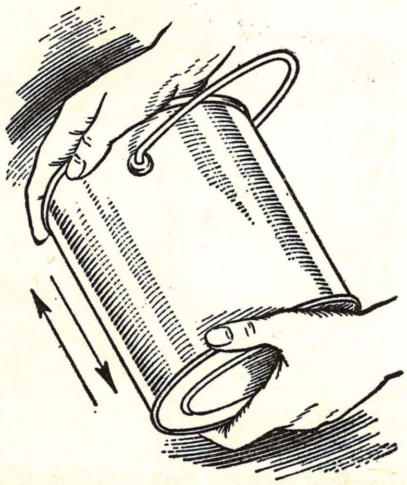


Fig. 164—Shake vigorously

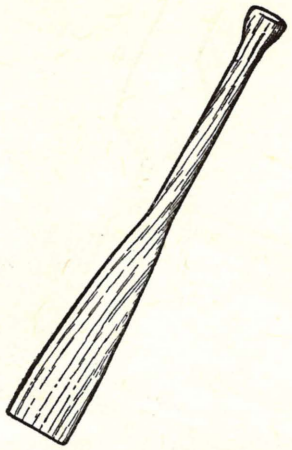


Fig. 165—Paint paddle square on end

What Kind of a Job Did You Do?

1. Did you spill much paint?
2. Is the paint well mixed?
3. Is the paint free from dirt and lumps?
4. When should turpentine be added?
5. What danger is there in opening a can of paint?

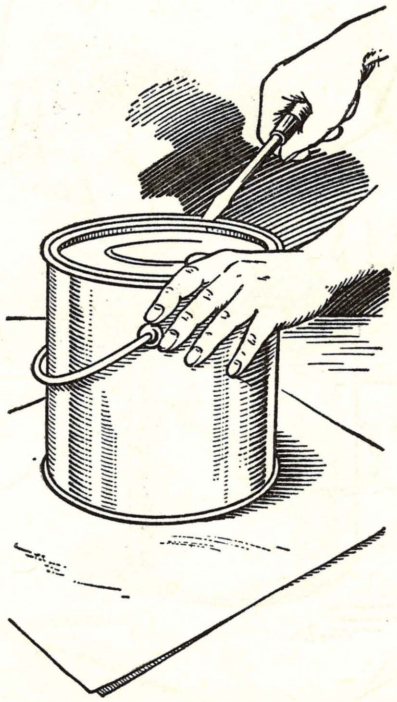


Fig. 166—Open can with screwdriver. Keep hands clear in case screwdriver slips

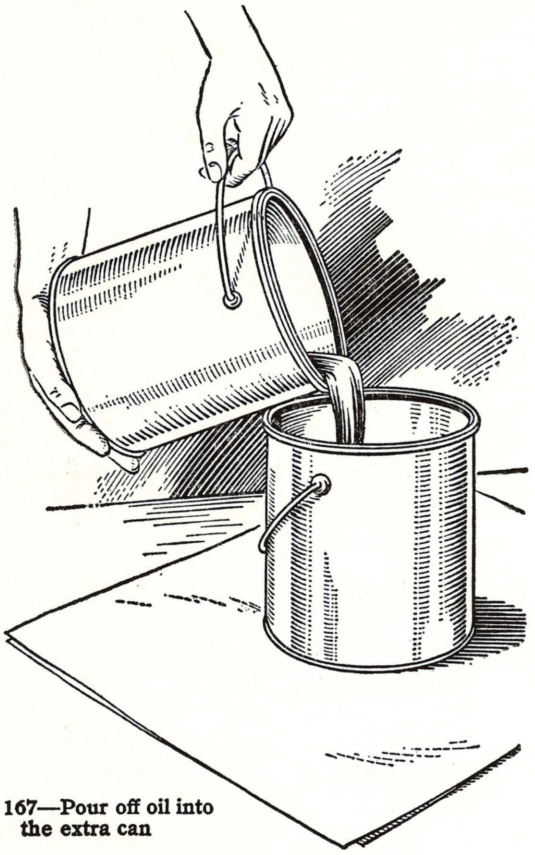


Fig. 167—Pour off oil into the extra can

Fig. 168—Mix the paste thoroughly from the bottom

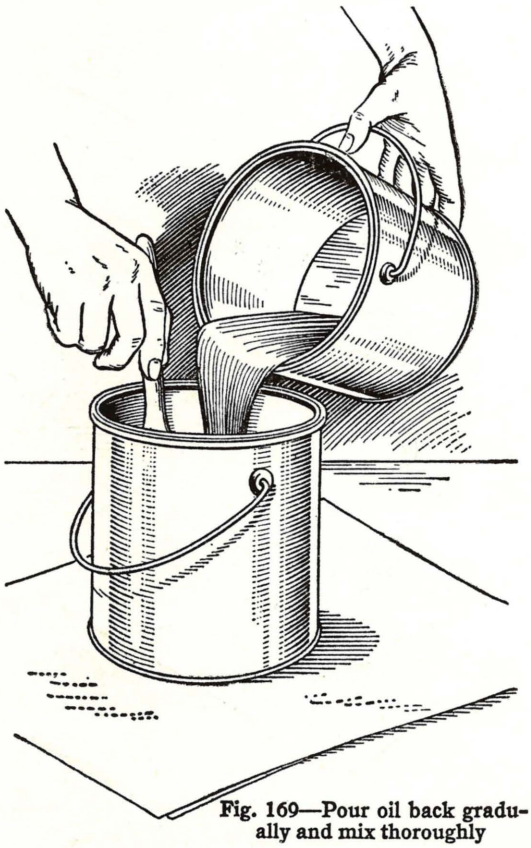


Fig. 169—Pour oil back gradually and mix thoroughly

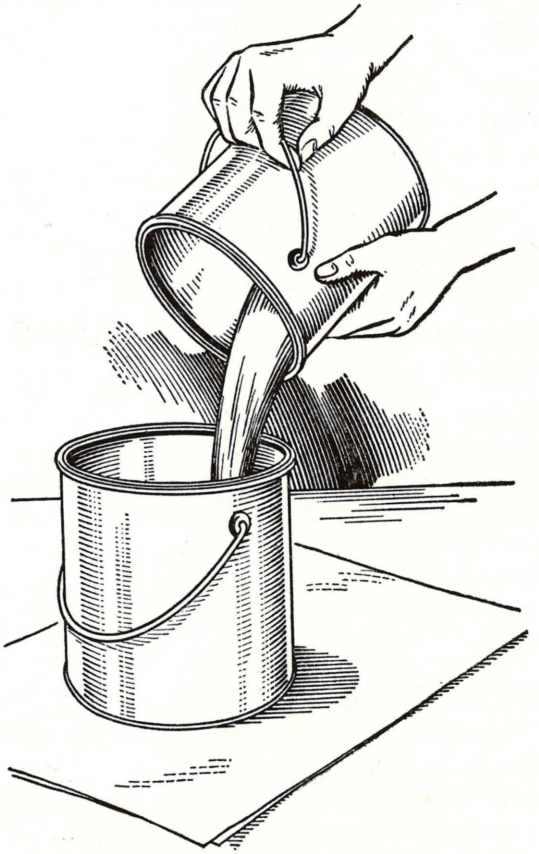


Fig. 170—Pour back and forth until thoroughly mixed. This process is known as boxing

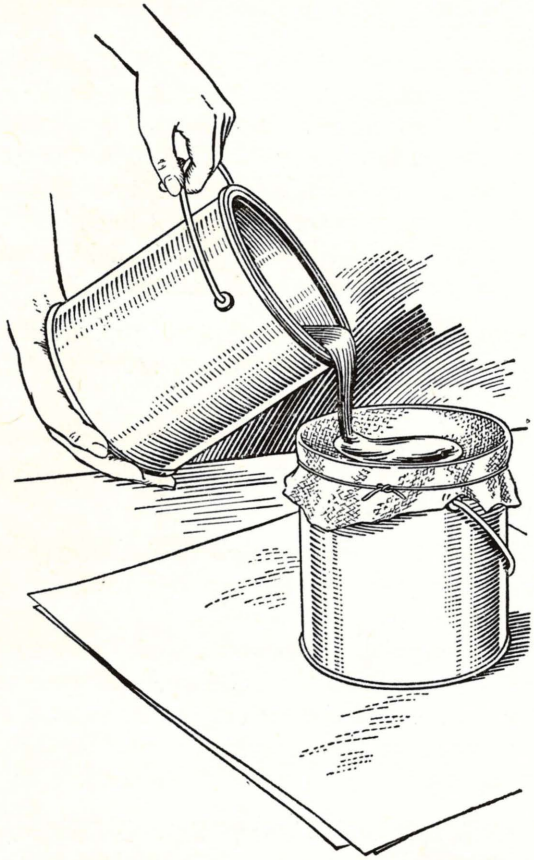


Fig. 171—Old paint which contains dirt or lumps should be strained through cheesecloth

Here Is a Plan for Mixing:

Fig. 172—Empty enough paint for one coat into the large mixing can. Clean the cans with turpentine

JOB NO. 34

HOW TO MIX SEVERAL CANS OF PAINT

When painting a house or a garage, more than one can of paint will be required. Ready-mixed paint is supposed to be uniform in color, but this is not always true. There may be enough variation to show up in the finished job if one can is used up before opening another. To prevent this, enough paint should be mixed at one time to give the entire job one coat.

Materials and Equipment Needed

Turpentine and linseed oil may be needed if the paint is for a priming or second coat. A large can should be selected which will hold about twice the amount of paint needed. The can should have a lid so that dirt can be kept out. A strong paint paddle will be needed for stirring.

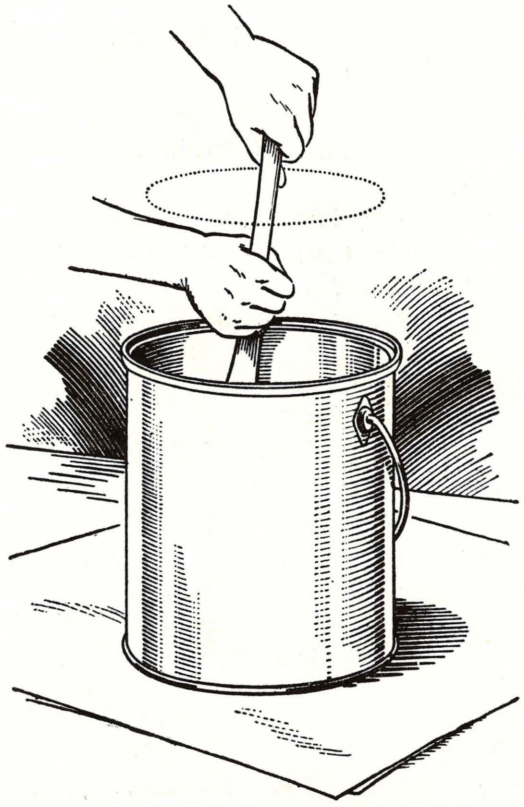


Fig. 173—Stir until thoroughly mixed

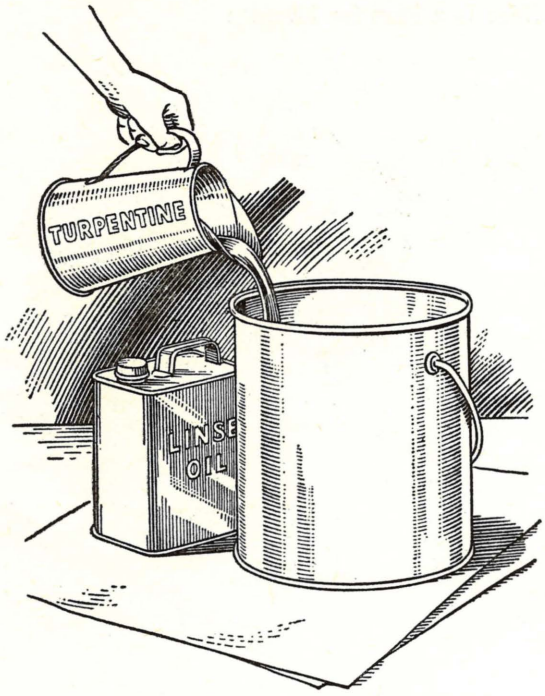


Fig. 174—Add linseed oil and turpentine if necessary and mix

Strain out dirt and lumps if necessary. See Job No. 33.

Decide How Well You Have Done After Answering These Questions.

1. Did you spill any paint?
2. Did you clean all of the paint out of the small cans?
3. Are there any lumps in the paint?
4. Is the paint the same thickness on the top as on the bottom?
5. When is linseed oil added to outside paint?

JOB NO. 35

HOW TO TINT PAINT

Tinting paint is a delicate job that very few people ever try to do. It may be because they can buy the shades they want, or it may be because they like what they can get and are too timid to try tinting. Anyway, it is a very useful and enjoyable thing to know how to do. White paint can be purchased for the entire interior of the house, and, with a few tubes of color ground in oil, small amounts may be tinted for different rooms and closets. A greater variety of color may be used in this way, and at less cost than buying them ready-mixed.

Materials Needed:

Enough white paint for the job, and a tube or can, of color ground in oil. White paint is best for tinting. Other shades may be darkened, but it should be done with extreme caution. It is not practical to try to change paint from a dark shade to a light shade. People who try this are apt to end up with several gallons before they get it light enough. Here are some common combinations.

Ochre, added to white paint will produce shades from light cream to pale yellow, according to the amount used.

Raw sienna, added to white paint will produce shades from light ivory to light brown according to the amount used.

Prussian blue will produce shades from a very pale blue to a dark blue. according to the amount used.

There are so many colors and combinations that it is impossible to list them all here. Ask your paint dealer to tell you the shades you need, or get his color chart. In all cases samples should be applied and allowed to dry, to observe the effect.

Here Is A Plan for Tinting Paint. Follow instructions carefully.

1. Place a small amount of color ground in oil, in a small tin can. An amount about half the size of a walnut will be enough to start.

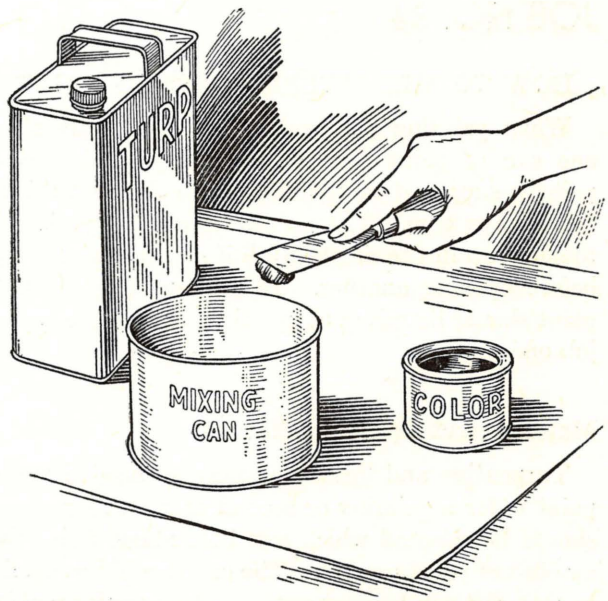


Fig. 175—Color ground in oil is thinned with turpentine before mixing with paint

2. Mix enough turpentine with the color to make it thin and watery. Be sure that there are no lumps. If the color is added to paint without thinning, it will not dissolve. Lumps of color will be smeared on the surface with the brush, causing streaks.
3. Pour a small amount of the mixed color into the white paint. Mix thoroughly. Try a little on a piece of wood to see how close you are to the shade desired. Oil paint darkens when dry.
4. Add more color as needed to mix the shade desired. It is very important that only a small amount be added at one time. The color is very powerful, and if too much is added, it takes a lot of white paint to make the shade lighter.

You Will Know How Well You Have Done If You Answer These Questions.

1. Did you get the shade you wanted?
2. How many times was it necessary to add color?
3. Why is color thinned with turpentine?
4. Can the color of paint be changed to a lighter shade?
5. What is the name of the color you used for tinting?

JOB NO. 36

HOW TO COMBINE PAINTS TO GET NEW COLORS

Quite often the household mechanic has need for paint of a certain color, and none is available. In such a case, it will save time and effort if he knows the proper color combinations to mix the color he needs.

Materials Needed:

A mixing can, and a paddle for each can of paint used.

Here Is the Method of Procedure for a Few Standard Colors.

1. To get gray paint, add a very small amount of black paint to white paint, and mix well. The more black added the darker gray the paint will be.
2. To get green paint, add a small amount of blue paint to yellow paint. The amount and kind of blue added will determine how dark the green will be.
3. To get orange paint, add a small amount of red paint to yellow paint.
4. To get brown paint, first make orange paint, and then add some black paint. The proportions of red and black used will determine the shade of brown.

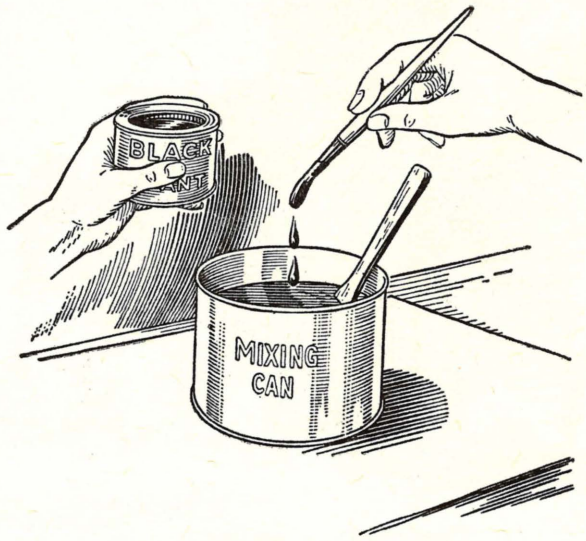


Fig. 176—Black paint may be added to white paint to make gray paint

Here Is a Job Test to Help You Decide How Well You Succeeded.

1. Did you get the color you wanted?
2. What would you do if there were lumps in the paint?
3. Does paint dry lighter or darker than it appears in the can?
4. If you spilled paint on the floor what would you use to wipe it up?
5. What will remove fresh paint from your clothes?

PROBLEMS IN OUTSIDE PAINTING

One, Two, or Three Coats

The question often arises as to whether one, two, or three coats of paint should be used. Three coats are recommended for new work. Each coat has a purpose.

The priming coat, or first coat is the penetrating or sealing coat. It is not supposed to add very much color to the finish. The paint should be thinned with linseed oil and turpentine. Usually about two quarts of linseed oil and a pint of turpentine are added to each gallon of ready-mixed paint. Always consult instructions given on the can. The turpentine thins the oil and pigment so that it penetrates the wood and does not form a

Fig. 177—A house should be painted once every three years

film on the outside of the wood. Paint often peels later because not enough turpentine was added to the priming coat to carry the pigment and oil into the pores of the wood. Allow three days for drying.

The second coat is thinned much less than the priming coat, therefore it adds much more color to the finish. Usually not more than a pint of linseed oil, and a half pint of turpentine are added to the gallon of ready-mixed paint. Again, be sure to consult the directions on the can. Turpentine is added to cause the paint to spread easier, and to dry with a dull finish. The last coat will spread easier and hold better if the finish of the second coat is not glossy. At least three days of dry weather should be allowed for drying.

The last coat of paint is usually applied as it comes from the can. Be sure to read the instructions on the can. Since it should dry with a gloss, no thinner of any kind should be added. It should be brushed out well with long even strokes.

Two Coats For Old Work

The number of coats of paint to be used on old work will depend on the condition of the surface to be painted. If three years have elapsed since it was last painted, two coats will be necessary under normal conditions. But if the last coat of paint did not wear well, and is peeling off in large spots, three coats may be necessary. On the other hand, if less than three years have elapsed, and the paint is in good condition, only one coat may be necessary. In other words, it all depends on the condition of the last coat of paint.

Common Complaints About Paint Jobs

Chalking Off is nothing to worry about. Good paint should come off in a fine powder when rubbed, after it has been on from one to two years. Not enough should come off, however, to expose the bare wood. If it chalks off sooner than one year, the quality of the paint used was poor, or it was thinned too much with turps or drier. All of this loose paint should be washed off before repainting.

Peeling off is one of the serious problems confronting the household mechanic. It should never happen, regardless of the length of time the paint has been on. There are a number of conditions which will cause paint to peel.

1. Poor paint was used.
2. The first coat did not have enough turpentine added to carry the oil and pigment into the wood.
3. The wood was wet when painted.
4. The wood was soaked with mineral oil.
5. Paint will raise and peel off over knots and pitchy spots if not properly sealed before painting.

Checking. Paint is apt to crack or check if not given enough time to dry between coats. Three or four days of ordinary dry weather should be allowed. More should be allowed if the temperature is below 70 degrees, or if the weather is rainy or damp.

JOB NO. 37

HOW TO USE OUTSIDE PAINT ON NEW LUMBER

The weather has a very bad effect on surfaces which are not painted. This is especially true of wood structures. Buildings which have been allowed to decay because of lack of paint may be seen in every community. Paint costs money, but not so much as new buildings. Painting is well worth while from the money standpoint, to say nothing of improvement in appearance.

Here Is a List of the Materials Needed.

Enough paint to do the job. A paint dealer can estimate the amount of paint needed. One gallon usually covers 500 square feet for the priming coat. The second and third coats require less.

Linseed oil and turpentine are needed for thinning the priming coat. Linseed oil is used for the following coats.

Putty is needed for filling the nail holes and cracks, and shellac for sealing the knots. Rags and sandpaper are needed for keeping the surface and equipment clean.

Here Is a List of the Equipment Needed.

Brushes for the paint and the shellac, a putty knife, a mixing can for the paint, a wire hook, a dusting brush, and a stiff wire brush.

Here Is a Plan for Painting New Work Which Has Never Been Painted.

1. Prepare the surface to be painted. The wood must be thoroughly dry. All dirt and grease must be removed. All knots and pitchy streaks in the wood should be sealed with shellac to prevent the pitch from coming through the paint.
2. Mix the paint thoroughly. Pour the liquid into the large mixing can. Be sure to mix the heavy material which has settled in the bottom of the can with the liquid. (See page 55.)
3. Prepare the priming coat. Add about ½ gallon of linseed oil and 1 pint of turpentine to each gallon of ready-mixed paint. More oil may be added if desired. (See page 57.)
4. Applying the priming coat. Dip the bristles of the brush only about one half their length. Set the paint in the brush by slapping the bristles gently against the inside of the can. Start painting at the top part of the surface to be painted, apply a thin, even coating, and brush in the direction of the grain of the wood.
5. Care for the paint brushes. (See page 50.)
6. Allow the paint to dry. This usually takes about three days, depending on the weather.
7. Putty all small cracks and nail holes. The puttying is done after the priming coat so that the wood will not absorb the oil from the putty.
8. Prepare the paint for the second coat. Mix the paint thoroughly as it comes from the can. From a pint to a quart of turpentine may be added to each gallon of paint for the second coat.

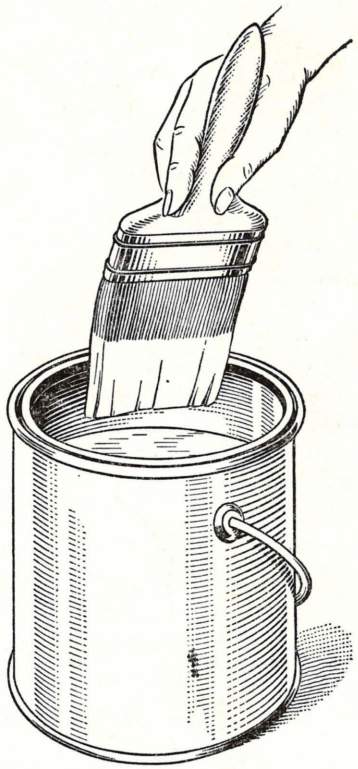


Fig. 178—Dip the brush only half way up on the bristles

9. Apply the second coat of paint. This coat should be applied in the same manner as the first coat. Be careful not to smear paint over things which are not to be painted.

   Caution: Be sure to care for the paint brushes, and burn the oily rags, every night.
10. Allow the second coat to dry. This will also require about three days. Be sure it is

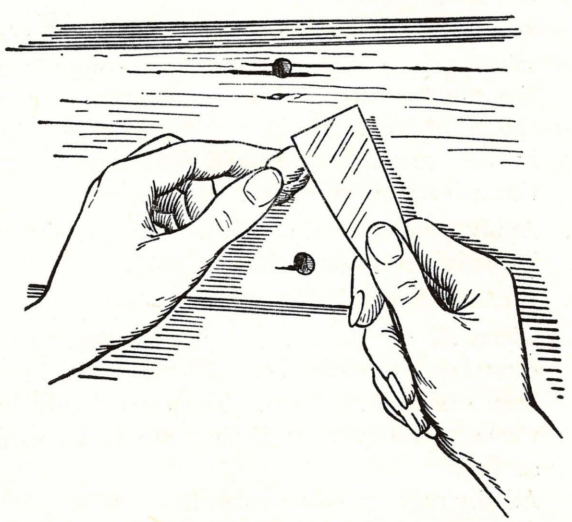


Fig. 179—Nail holes and cracks must be sealed with putty

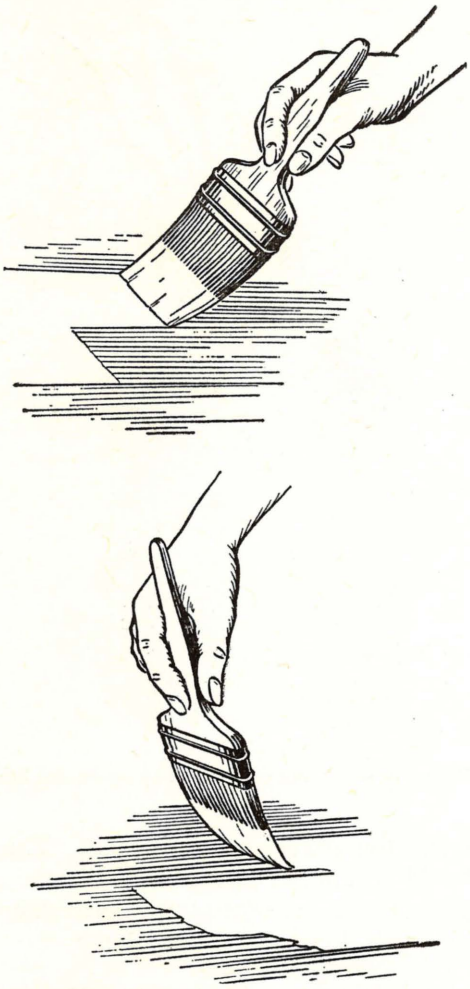


Fig. 180—Hold the brush with a pencil grip so that you can brush in either direction

thoroughly dry before applying the next coat of paint.

11. Prepare the paint for the third coat. Ready mixed paint can be used just as it comes from the can for the third coat. Be sure to mix the paint well. If there are any fatty skins in the paint, they should be strained out through a piece of screen.
12. Apply the third coat of paint. Use special care in applying as this is the final coat.
13. Clean paint brushes for storing. (See page 50.)
14. Clean all equipment. All ladders and paint cans should be cleaned of paint which may have been smeared on them. The cans should be washed with gasoline if they are to be used again.

    All oily rags should be burned.

    Any extra paint should be poured into a can and sealed air tight for future use. The can should be as small as possible to hold all of the paint.

Did You Do a Good Job of Painting? The following questions may help you decide.

1. Are there any laps or brush marks on the surface?
2. Were all the nail holes puttied?
3. Is paint smeared on parts not supposed to be painted.
4. Are the brushes cleaned?
5. Have the oily rags been burned?

JOB NO. 38

HOW TO PAINT A SASH

In a previous lesson it was learned that water and ice get underneath the putty and raise it, if there is the least chance for it to do so. If the sash is painted properly this will not happen. The household mechanic should be very careful to seal the putty to the glass with paint. (See How to Replace Putty, page 172.)

Tools and Equipment Needed:

The ordinary sash brush and paint are necessary. A rag may be needed for wiping, and another for cleaning the sash for painting. Do not use the same rag for both. Scotch tape, or masking tape, may be used.

Here Is a Plan for Doing the Job. Follow instructions carefully.

1. Wipe all dust and dirt off the surface to be painted. It is often a good plan to wash the dirt off. In this case, be sure to allow the surface to dry thoroughly.
2. Paint the putty around the edge of the glass. Be sure to leave about one sixteenth of an inch of paint on the glass all the way around.

The painter's hand is well trained, and he can do this very rapidly, and leave a nice straight edge. The household mechanic however, is apt to find that he is not able to leave a nice straight edge, and get much work done. Here is a method by which he can make very good time, and have a perfect edge when finished.

Apply scotch tape, or masking tape to the glass, one sixteenth of an inch from the putty. Paint the sash as usual, but allow the paint to extend over the edge of the tape. After all coats of paint have

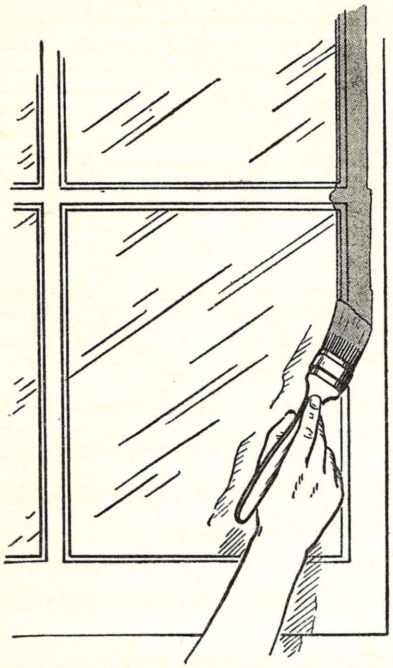


Fig. 181—About one sixteenth of an inch of paint should be left on the glass

dried, remove the tape, and the edge will be nice and even.

This is also a good idea on the inside of the sash, although not nearly as essential. As long as the

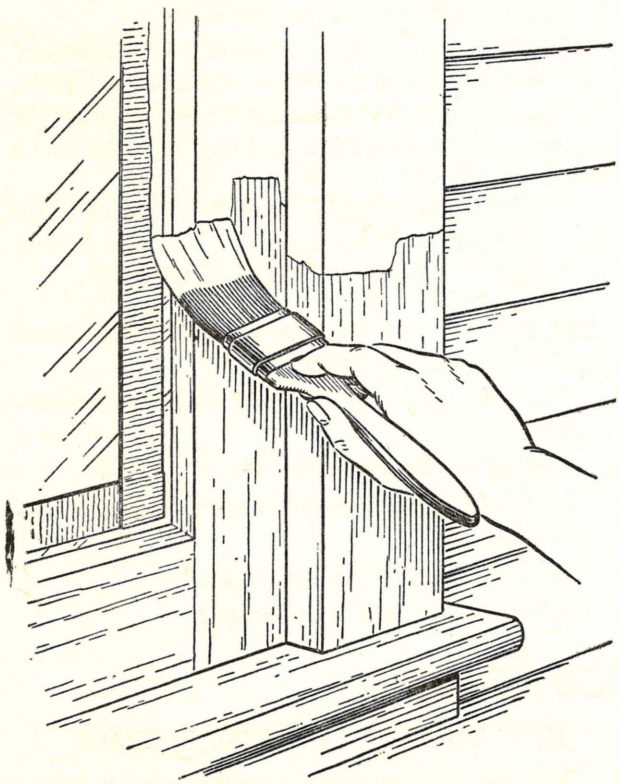


Fig. 182—Apply masking tape when sealing the glass and putty

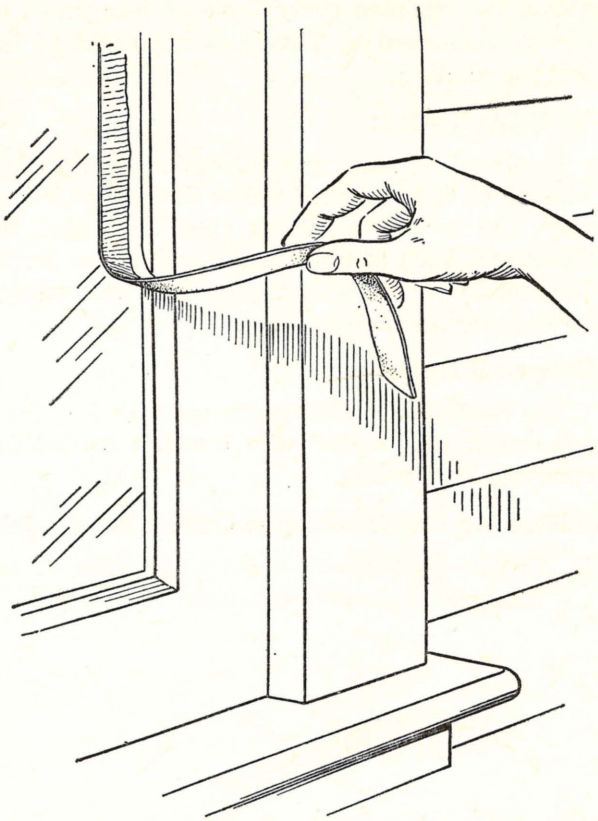


Fig. 183—Remove tape after all coats of paint have dried

paint extends beyond the putty on the outside, it may as well be the same way on the inside. NOTE TO THE HOUSEHOLD MECHANIC: Except for the instructions just given, paint should be applied to the sash in the same manner as in either outside or inside painting. Follow instructions given in either Jobs No. 37 or 41.

How Successful Was the Job? Did You Use the Tape?

1. What happens when water freezes in cracks between the putty and the glass?
2. What precaution should be taken when scraping paint off window glass?
3. Is ordinary paint used when painting the putty?
4. If tape is used, when should it be removed?
5. What two kinds of tape are commonly used?

JOB NO. 39

HOW TO REPAINT A SURFACE, USING OUTSIDE PAINT

The buildings at home often need repainting to brighten them, and to preserve the wood. They

should be repainted every three or four years, or oftener if necessary. This is as important as the original painting.

Materials Needed:

Ready-mixed paint and turpentine for thinning. Linseed oil is not needed unless the surface is in a very bad condition. Putty may be needed for filling nail holes and shellac for sealing the knots. Rag, sandpaper and a strong soap may be necessary for cleaning the surface.

Equipment Needed:

The equipment should be the same as for a new job except that a stiff wire brush is needed for removing loose paint.

Here Is a Plan for Doing an Outside Repaint Job.

1. Prepare the surface. This is the most important part of the job and should be done well.

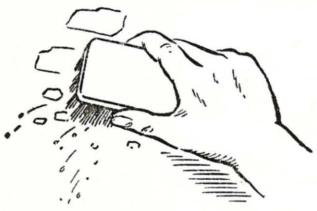


Fig. 184—Use the wire brush to remove dirt and scale.

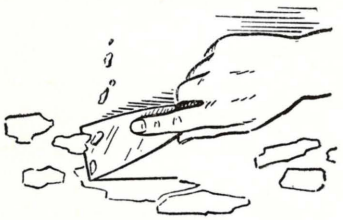


Fig. 185—Remove loose paint with putty knife and wire brush

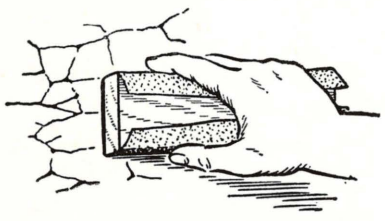


Fig. 186—Sandpaper checked surfaces

2. Shellac knots or pitchy places which are exposed.
3. Mix the paint for the first coat. Turpentine, and possibly linseed oil will be used. If three coats are to be applied, mix as for new work. Usually only two coats will be used. In this case, mix as for the second coat in new work. Some turpentine should be used.

Fig. 187—The surface must be clean and smooth before paint is applied. Wash siding with strong soap or sal soda and water. Rinse off soap with a hose.

4. Apply the first coat over the old paint. Allow three days for drying.
5. Care for paint brushes. (See page 50.)
6. Renail the siding where old nails have pulled out.
7. Putty nail holes and cracks. Be sure to force the putty to the bottom of the cracks if possible.
8. Mix the paint for the second coat. This will usually be the last coat. Do not add turpentine unless a third coat is to be applied. The last coat of outside paint should dry with a gloss.
9. Care for brushes. (See page 50.)

All ladders and paint cans should be cleaned of paint which may have been smeared on them. The cans should be washed with a "thinner" if they are to be used again. All oily rags should be burned every night.

Any extra paint should be poured into cans for future use and sealed air tight. The can should be as small as possible to hold all of the paint.

Did You Do a Good Job of Painting? These questions may help you decide.

1. Are there any runs or brush marks on the surface?
2. Is all of the surface covered?
3. Is there any paint smeared where it is not supposed to be?
4. Have the brushes been cared for?
5. Have the oily rags been burned?

JOB NO. 40

HOW TO PAINT A METAL SURFACE

Eave troughs, rain spouts, gutters, and flashings are often made of galvanized iron. Galvanized

iron will resist rust for a time, but in a year or two, rust spots will usually appear. Then it is but a short time until it is rusted through and has to be replaced. This can be prevented by keeping the surface covered with paint. The household mechanic can do this job.

Materials Needed:

A can of metal primer, and a can of regular outside paint the color desired. Flashings are often painted the same color as the shingles. Sandpaper, emery cloth, or steel wool will be needed if the metal is rusty. Rags will be needed for cleaning.

Equipment Needed:

A ladder will probably be necessary. The brush used for applying the primer may be cleaned and used again in the paint. A hose may be needed for washing leaves and dirt out of the eave troughs.

Use This Plan When You Do the Job: Also, Use the Ladder Carefully.

1. Prepare the surface. The metal must be clean. Paint will not stick to dirt, rust, or grease. If the eave troughs are full of leaves and dirt, wash them out with a hose and a rag. Rust spots should be sanded bright with sandpaper or emery cloth. Grease or soldering flux left by the tinsmith must be cleaned off. Paint will stick much better to galvanized iron if the zinc is tarnished. For this reason, new flashings or spouting should be left for a few weeks before painting.
2. Mix the metal primer. It is usually red in color, having a base of red lead.
3. Apply the metal primer. It will usually be necessary to use a ladder. Be sure it is set firmly on the ground.
4. Allow about three days to dry.
5. Clean the paint brush. Use the same cleaner as for ordinary house paint.

Fig. 188—A ladder will have to be used to paint eave troughs

6. Mix the house paint, as for the second coat on wood. Two coats will usually be necessary to cover the red primer. This is especially true if white, or any light color is used. When painting flashings, possible one coat of dark colored paint will be enough to cover the red.
7. Apply the paint as for wood. (See Job No. 37.)
8. Care for brushes and equipment. (See page Nos. 49 to 52.)

Did You Do a Good Job? Here Is a Job Test for Your Benefit.

1. Why is it necessary to use metal primer?
2. Metal primer is usually some shade of _____.
3. Why is it that color?
4. Why should galvanized iron weather before painting?
5. How should a brush used in metal primer be cleaned?

PROBLEMS IN INSIDE PAINTING

Outside paint, we learned, deteriorates because of exposure to the weather. Inside paint has to be repainted from time to time for other reasons. It wears off from constant use. This can usually be noticed on doors, drawers, and other woodwork which comes in direct contact with people. Paint wears off the seats and legs of chairs, and becomes so badly marred that they have to be repainted. Paint which is washed every day with soap and water comes off to the bare wood before the paint in other places shows any signs of wear. Walls become dirty and have to be washed. A wall will stand two or three washings with soap and water, and then it begins to need repainting. So inside paint has to be able to stand washing, and to stand the abuse of people coming in contact with it.

How Many Coats for New Work

For new inside woodwork, furniture, and plastered walls, three coats are usually applied. People who are very particular, sometimes use four or five coats. Let us see what purpose each coat serves.

The priming coat, or first coat, is applied very thinly so that it will penetrate the pores of the wood or plaster. In doing this, it provides a good foundation for the next coat. In other words, it provides the "teeth" which make the paint hold or stick. Enamel undercoating thinned with turpentine is usually used for the priming coat on woodwork. Sometimes, thinned shellac is used. A special "first

coat" or sealer is generally used for new plastered walls.

The first coat does not add a great amount of color. It is the second coat which really shows results. In other words, the second coat "covers." Enamel undercoating should be used for the second coat, usually as it comes from the can. That is, it is used without thinning. It should not be used until the priming coat is thoroughly dry. This takes from twenty-four to forty-eight hours. The first coat should also be sanded and free from dust. Enamel undercoating should be the same color as the enamel to be used. An extra coat of undercoating is sometimes used to produce an especially good foundation for the enamel.

Enamel is usually the third coat. It dries with a hard finish, and may be purchased in dull, semi-gloss, or glossy finishes. It is very important that the surface to which it is applied be sanded smooth, and wiped free from dust. Otherwise, dust particles appear as tiny specks on the surface of the enamel. A "tack rag" is often used for this purpose. More than one coat of enamel may be used to get an especially good finish. When an extra coat is used on a glossy surface, the surface must be thoroughly dry, and rubbed dull and smooth with fine steel wool or sandpaper. Always allow enamel from several days to a week before rubbing. It dries quickly on the surface, but slowly underneath.

How Many Coats for Old Work

The condition of the surface to be painted will determine the number of coats to be used. In most cases, two coats are enough. In some cases, one coat of enamel will do.

Two coats are used where the old paint has been worn off in places, or where the color is being changed. For instance, one coat of white enamel over a red surface would not cover. At least one coat of white enamel undercoating should be used. Enamel undercoating of the same color as the enamel should always be used.

One coat will be enough where the enamel to be applied is the same color as the old surface and the old surface is in good condition. The old surface must be washed clean, and the finish rubbed dull with fine steel wool or sandpaper before the new coat of enamel is applied.

Common Complaints About Inside Paint Jobs

Paint does not stick to dirty, rusty, soapy, or greasy surfaces. Woodwork and plaster around sinks often have soap on the surface. This must be washed and sanded off. Children's high chairs, tables, and other furniture are usually covered with grease from food spilled on them. This must be scraped and washed off. It is often a good idea to clean such surfaces with turpentine or benzine. Grease on children's tricycles, coaster wagons, etc., should be washed off with gasoline. Rust spots must be sanded down to the bright metal. In other words, if the surface is not clean, paint will not stick.

Paint Does Not Wear Well. The reasons for this are much the same as for paint not sticking, with one addition. The paint used was probably poor paint. Do not expect to save money by buying bargain paints. You may be lucky, but the chances are that you are buying an inferior grade.

Checking. The common cause of paint checking is applying paint before the preceding coat has had a chance to dry thoroughly. This causes uneven drying, and checking is the result. On window sills and sashes the paint often checks because of moisture. Storm windows reduce this problem.

Sags and runs in enamel may be the result of any of several things.

1. The enamel was too thick when applied. It should have been thinner and easier to spread.
2. Too much enamel was used. The result was that the enamel ran down the surface and dried before it reached the bottom.
3. The enamel was not applied evenly, or was not spread out evenly with the brush.
4. A poor brush was used. An enameling brush should have thick heavy bristles which have enough body to spread the enamel instead of just sliding over the top.
5. The room was too cold. 70° to 80° F. is a satisfactory temperature.

How to Make a Tack Rag

When applying enamel or varnish, it is very important to have the surface free from dust. The ordinary dry rag often leaves as much dust behind it as it picks up. A tack rag will pick up the dust and hold it. Here is the way to make one. Fold a piece of clean cloth, cheese cloth preferred, several times and spread it out flat on a bench. Wet the cloth in various spots with varnish. Then roll it up and wring, or squeeze it so that the varnish will penetrate the entire cloth. The cloth should not be wet, just tacky, or sticky. If you did not get enough varnish the first time, add some more. If

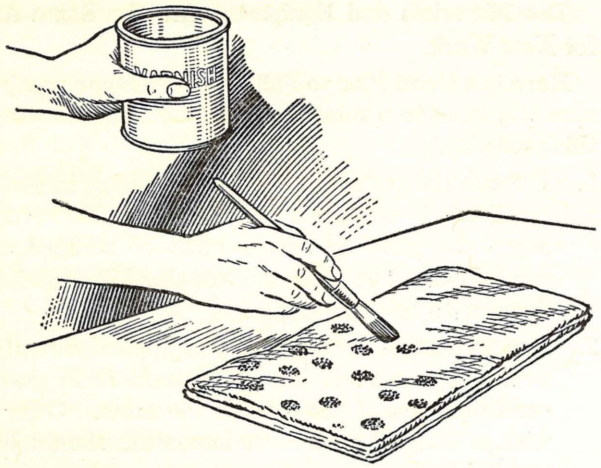


Fig. 189—A tack rag is made of cheese cloth dampened with varnish

you got too much, fold in some more cloth and squeeze it again.

Caution: Do not leave tack rags lying around. Place them in a fireproof container, or burn them. Otherwise they might start a fire.

JOB NO. 41

HOW TO APPLY INSIDE PAINT AND ENAMEL TO NEW WOOD

All interior woodwork, chairs and tables are much easier to keep clean if they are painted. Many small jobs of painting can be done very well by the home workman. The improvement in appearance and sanitation is well worth the time and expense. It is a common practice now to buy unpainted furniture and paint it at home.

Here Are the Materials You Will Need:

A can of enamel undercoating and a can of enamel the same color. Turpentine will be needed for thinning the first coat of enamel undercoating.

Putty will be needed for filling cracks and nail holes. Sandpaper will be needed for smoothing rough surfaces, and rags for cleaning the surface.

Here Is the Equipment You Will Need:

A clean paint can for dipping the brush. Do not try to dip the brush in a full can of paint.

A paint brush of a convenient size should be used. For small jobs such as chairs and windows a regular sash brush about $1\frac{1}{2}$ or 2 inches wide is a convenient size.

A putty knife may be used for filling nail holes. A ladder will be needed if the place to be painted is high. A canvas drop or newspapers will be needed for covering the floor.

Here Is a Good Plan for Painting a New Kitchen Chair.

1. Prepare the surface. All surfaces should be clean and dry. If there are any rough spots, they should be smoothed with sandpaper.
2. Cover the floor with a canvas drop, or old newspapers, to keep the floor clean.
3. Prepare the priming coat. It is a good plan to follow the instructions given on the can. Turpentine is usually added.
4. Apply the priming coat. Do not attempt to produce a finished looking job with this coat. Brush the paint well into the wood.

   A chair is much easier to paint if it is turned upside down on a table or box, and the legs and bottom painted first.

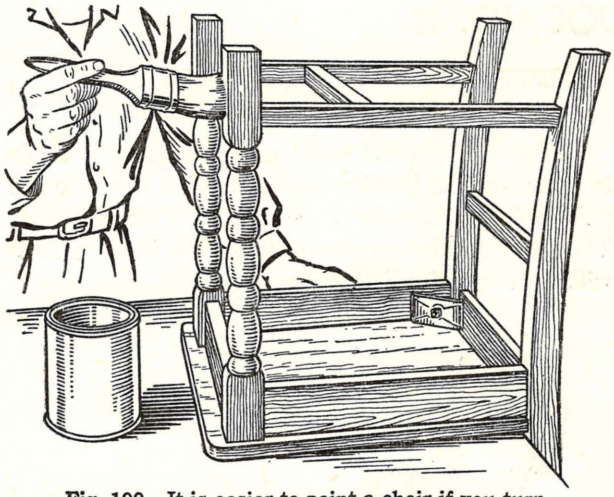


Fig. 190—It is easier to paint a chair if you turn it upside down and paint the legs first

5. Care for the brushes and burn the oily rags.
6. Allow 24 hours or more for the paint to dry.
7. Smooth runs and rough spots with sandpaper.
8. Fill all small cracks and nail holes with putty.
9. Prepare and apply the second coat. See the directions given on the can for mixing.
10. Care for the paint brushes and burn the oily rags.
11. Allow the second coat from 24 to 48 hours to dry, and sand the surface smooth.
12. Mix and apply the enamel. This coat should be applied in a room free from dust, and where the temperature is from 70 to 80 degrees. The finish may be left glossy, or the gloss may be removed by rubbing with very fine pumice

stone and polishing oil. Sometimes several coats of enamel are applied in order to get the finish desired. In such a case, remove the gloss between coats.

13. Care for brushes and rags. Store left over paint. (See page 50.)

Are You Satisfied With the Finished Job? The following questions may help you decide how well you have done.

1. How many coats of flat paint did you use?
2. Did you smooth the surface with sandpaper between coats?
3. Is the surface smooth?
4. How many coats of enamel did you use?
5. What should be done to the surface between coats of enamel?

JOB NO. 42

HOW TO APPLY INSIDE PAINT AND ENAMEL OVER OLD PAINT

Quite often an old chair or table may be made to look very attractive when given a new coat of paint. Toys may be repainted to look like new. The home repairman can do this work easily if he is willing to spend a little time.

Fig. 191—Enamel may be applied directly over old enamel

The Materials and Equipment Are the Same As for New Work.

Here Is a Good Plan to Follow. The home repairman will have to use his own judgment in following this procedure.

1. Prepare the surface. If the old paint is in good condition it need not be removed. However, any loose paint or checks must be scraped or sanded off. The entire surface should be sanded down with fine sandpaper.
2. A new coat of enamel may be applied directly over old enamel if the old enamel is in good condition, and if the color is the same. Otherwise, a coat of enamel undercoating should be applied first.
3. Care for brushes and burn oily rags.
4. Allow the paint or enamel to dry thoroughly, and proceed as for new work.

Answer These Questions After You Have Finished the Job.

1. Does the finished job look well?
2. Are there any rough surfaces?
3. How many coats of paint were used?
4. How many coats of enamel were used?
5. Why should oily rags be burned?

JOB NO. 43

HOW TO PAINT A PLASTERED WALL

Walls in the kitchen and bathroom are usually painted to aid in appearance and sanitation. Gloss paint is desired for the finish coat because it is not harmed by steam and can be washed without injuring the finish. Walls in other rooms are usually painted with a dull or egg-shell finish paint. The home repairman can do this painting very well if he is willing to follow a few instructions carefully.

These Are the Necessary Materials.

Enough wall paint to do the job. For kitchen or bathroom walls, both flat paint and gloss paint should be used. Turpentine will be needed for thinning. White lead putty, and possibly some patching plaster will be necessary if there are any holes in the plaster. Washing powder and rags are needed for cleaning the walls. Newspapers or a cloth drop are necessary for covering the floor, and either glue or varnish "sizing" will be needed for new walls which have not been painted before.

Fig. 192—Start painting in a corner and paint around the room

The Equipment Should Be As Follows:

Cans and brushes are needed for the paint and the sizing. A good wall brush about 3″ or 4″ wide is a convenient size. A putty knife is needed for patching holes, and a good step ladder may be necessary.

Here Is a Good Plan for Painting a Wall. Be sure to read all instructions carefully before starting the job.

1. Prepare the surface. A new wall should be thoroughly dry before an attempt is made to paint it. Many people think that it is not a good plan to paint a new wall until a year after it is plastered. Apply a coat of sealer or sizing to prevent the plaster from absorbing all of the oil from the paint.

   An old painted wall must be cleaned thoroughly. It should be washed with a washing powder or soap dissolved in warm water. All loose plaster should be removed, and all holes repaired with patching plaster. Full directions will be found on the box of patching plaster. All dents and small cracks should be filled with white lead putty.
2. Cover the floor with a canvas drop or old newspapers.
3. Mix the paint for the first coat. This will be a coat of flat paint. Be sure to mix it well. Directions are usually given on the can for thinning the first coat. If not, ½ pint of turpentine is generally used for a gallon of paint.
4. Apply the first coat. There is no grain to follow in painting plaster, as in painting wood. The brush strokes may run in a variety of ways. The main thing is to prevent brush marks or laps from showing.
5. Care for the brush, and burn all oily rags.
6. Allow 24 hours for drying.
7. Prepare the second coat. Flat paint may be used as it comes from the can for this coat.

   Note: If the wall being painted is an old wall that has been painted before, and if the paint is in good condition, steps 7, 8, and 9 may be omitted.
8. Apply the second coat and care for the brush and rags.

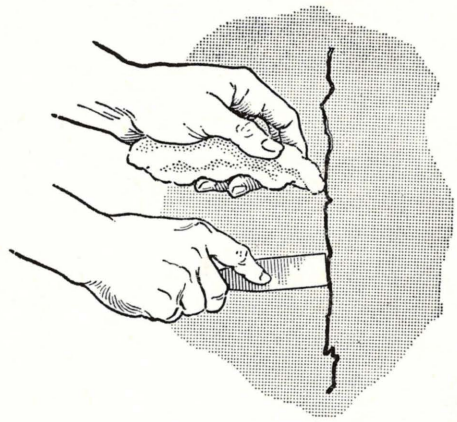


Fig. 193—Fill cracks in a plastered wall with putty

9. Allow 24 hours for drying. It is sometimes a good plan to allow even more time, depending on the weather and the temperature of the room.
10. Prepare the enamel for the third coat. It should not be thinned unless very thick. Be sure to mix well. Keep the room warm.
11. Apply the enamel coat, and care for the brushes. It will require 24 hours or more for the enamel to dry so that the room can be used without danger of damaging the paint.
12. Clean and care for the equipment. Store any left over paint.

How Does the Finished Wall Look? What do others think? The following questions may help you decide how good the job is.

1. Do any cracks and nail holes show through the paint?
2. Do any brush marks show?
3. Is the surface smooth and even?
4. Why is sealer used on new plaster?
5. What causes enamel to sag?

JOB NO. 44

HOW TO USE KALSOMINE

People often kalsomine the walls and especially the ceilings of bedrooms. It is cheaper than paint or wall paper and can be changed oftener. It is also easy to apply. Whitewash is applied to basement walls and fences in the same manner. It is an easy job, and the home repairman can do it after a few simple instructions.

Here Are the Necessary Materials:

A box of kalsomine or water paint. It can be purchased in the color desired. It is in the form of powder and must be mixed according to the directions found on the box.

The Following Equipment Will Be Needed:

A pail or can to use in mixing the kalsomine.

A pail or can to use for dipping the brush. The same can may be used in washing off the old kalsomine.

A kalsomine brush. This is a large brush made especially for applying kalsomine. A large paint

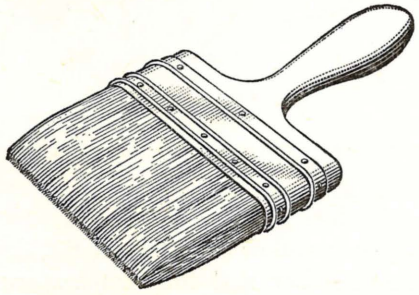


Fig. 194—A kalsomine brush

brush can be used, but is not so convenient. If a paint brush is used, it must be absolutely free from paint or oil.

Patching plaster to fill up the holes in the wall if necessary.

Newspapers or a drop cloth for covering the floor.

Here Is a Plan for Applying Kalsomine. Be sure to follow instructions carefully if you want to do a good job.

1. Cover the floors with newspapers or drop cloth. This is important, because water paints are sure to drop from the brush.
2. Wash off the old kalsomine with warm water. This should be done with a rag. A good job of kalsomining cannot be done over a dirty wall.
3. Fill any cracks with patching plaster. Patching plaster is preferred to putty because it does not contain oil.
4. Mix the kalsomine. Instructions will be found on the package.
5. Apply the kalsomine. While the kalsomine is wet, it is considerably darker than it will be after it dries. Be sure to cover all of the surface, as only one coat is needed. Do not try to retouch the work. The quality or color cannot be judged until it is dry.
6. Clean the equipment used and allow the kalsomine to dry. Warm water is best for this cleaning. If the brush is well cared for it will last for many years.

When the Kalsomine Is Dry Try to Judge How Good a Job You Have Done. Then answer the following questions.

1. Are there any bare spots?
2. Are there any spots which were not filled?
3. Does the surface look streaked?
4. Why is patching plaster used for filling cracks instead of putty?
5. Is a kalsomined surface washable?

JOB NO. 45

HOW TO PAINT A COASTER WAGON

A newly-painted coaster wagon or bicycle almost takes the place of a new one, especially if the job is well done. The household mechanic can bring joy to the family by keeping the toys bright and shiny with new paint and enamel.

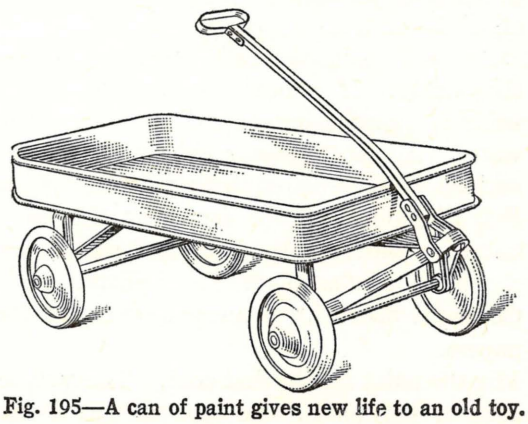


Fig. 195—A can of paint gives new life to an old toy.

Materials Needed:

A can of metal primer, a can of flat paint, and a can of enamel. The flat paint and the enamel should be the same color. Also, fine sandpaper, about No. 3/0, coarse sandpaper, about No. 1, a tack rag, and the usual rags for wiping, cans, and paper for the floor. Benzine, or some other cleaning fluid will be needed for washing off the grease.

Equipment Needed:

A sash brush is a handy size for this job. A wrench, screw driver, pliers, and a can for small parts will also be needed for removing parts which can be removed easily. Wires will be needed to serve as drying racks for wheels and other parts.

Follow This Plan Closely. It Should Help You Do a Good Job.

1. Remove wheels, front axle, and other parts which will come off easily. This is not absolutely necessary, but it makes the painting easier.

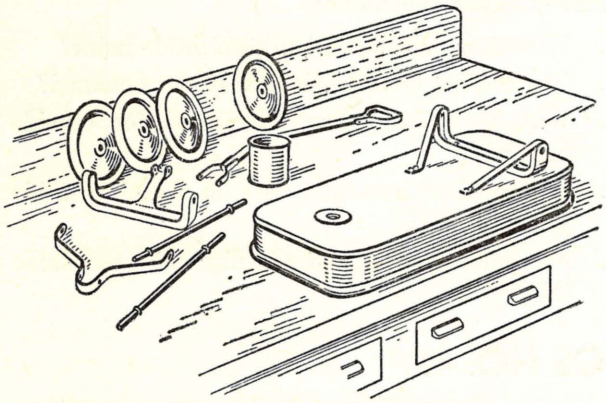


Fig. 196—Painting and cleaning will be easier if the removable parts are removed

2. Clean off all grease and dirt with benzine or other cleaning fluid. When the cleaning fluid has evaporated, wipe the surface carefully with a rag soaked with turpentine.
3. Sandpaper all rust spots with No. 1 sandpaper until there is no trace of rust left, and until the paint on the edge of the spots is neatly beveled with the metal. Steel wool or emery cloth may be used in place of sandpaper.
4. Sandpaper all nicks and scratches clear down to the metal, and bevel the edges of the paint as for rust spots.
5. Dull the finish of the paint which is still good with sandpaper, steel wool, or emery cloth.
6. Paint all bare spots with metal primer. Sometimes two coats are necessary in order to get it to cover well. Allow 24 hours between coats for drying.
7. Sand lightly with No. 3/0 sandpaper, and attempt to level the primer off with the surrounding paint.
8. Apply flat paint over the entire surface. Enamel may be used instead of flat paint. Hang parts on wires to dry. Allow 3 or 4 days for drying.

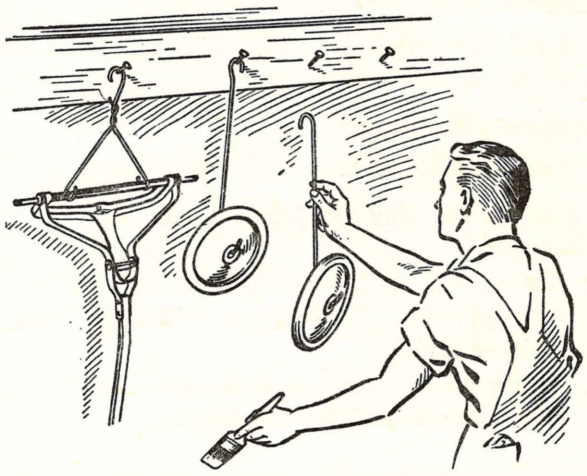


Fig. 197—The parts will dry better if hung on wires

9. Sandpaper entire surface lightly with No. 3/0 sandpaper.
10. Remove all traces of dust with the tack rag. Not only should dust be removed from the surfaces to be painted, but the entire room should be as free from dust as possible.
11. Apply the final coat of enamel, and allow three or four days to dry before handling.
12. Grease all working parts and assemble.
13. If striping or painted decoration is desired, see jobs No. 46 and 47.
14. Temperature should be about 70° F.

How Good a Painting Job Did You Do? Here Is a Job Test.

1. Why is metal primer used?
2. Why was it necessary to remove the grease?
3. What was used on the surface after the grease was cleaned off?
4. Why was it necessary to remove rust?
5. How long should enamel dry before it can be sanded?

JOB NO. 46

HOW TO DO STRIPING THE EASY WAY

An expert striper can take a striping brush and paint a stripe around the edge of a table top so well that it looks very attractive. The household mechanic cannot be expected to do this, but there are other ways of doing the same thing that the household mechanic can use.

Materials Required:

A roll of scotch tape, or masking tape, and the color paint to be used.

Equipment Necessary:

A small paint brush.

Here Is the Way the Job Is Done. Be sure to follow closely.

1. Be sure the surface on which the stripe is to be painted is dry. Masking tape will ruin a freshly painted surface.
2. Apply masking tape on both sides of the space where the stripe is to be painted.

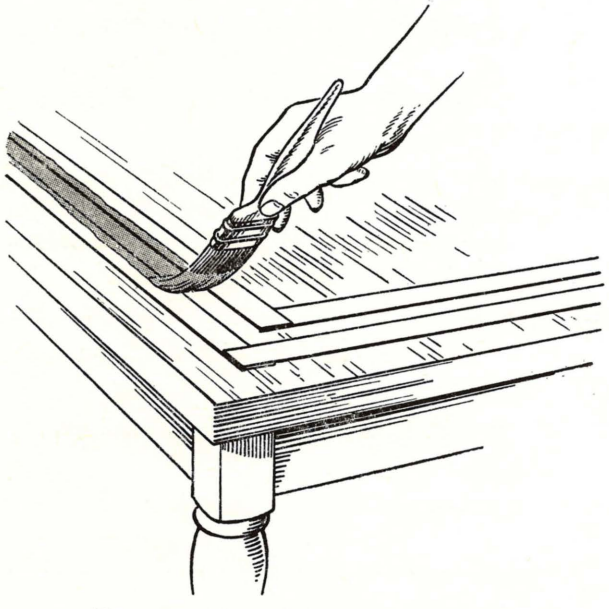


Fig. 198—Stripes may be painted between strips of masking tape

3. Apply paint with a small brush between the strips of masking tape. Paint which goes onto the tape does no harm.
4. Allow the paint to dry.
5. Remove the masking tape, and the stripe is perfect.

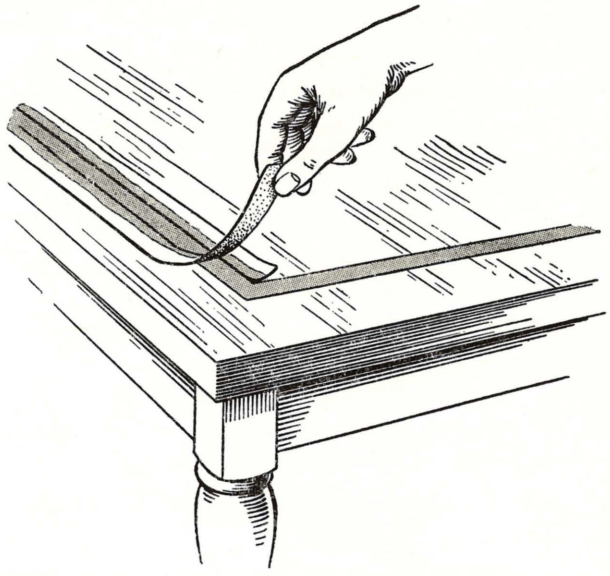


Fig. 199—Remove the masking tape with the fingers

Are You Satisfied With the Job? Can You Answer These Questions?

1. What is generally used to thin inside paint?
2. Can enamel be applied directly over enamel?
3. Why is inside paint never used for outside painting?
4. Is linseed oil generally used in thinning inside paints?
5. Are colors in oil and oil pigments the same thing?

JOB NO. 47

HOW TO STENCIL A DESIGN ON A PAINTED SURFACE

Stenciled borders and designs are very popular for walls, furniture, and toys. It is surprising how good a job the household mechanic can do if he will follow directions carefully.

Materials Needed:

First of all, a stencil is needed. It may be purchased at the hardware or paint store, or the household mechanic may cut it himself out of cardboard. Paint will also be required. Special stencil paint is best because it is thick. But ordinary paint will work if used properly. Be sure to get a color which will harmonize with the wall paint.

Equipment Needed:

A regular stencil brush is best, but the work can be done with an ordinary small paint brush. A

ruler and a pencil are often necessary to get the stencil where it should be.

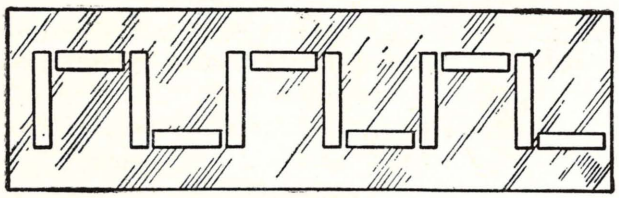


Fig. 200—Border Stencil

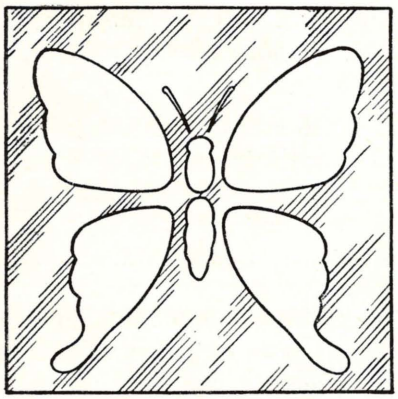


Fig. 201—Design stencil

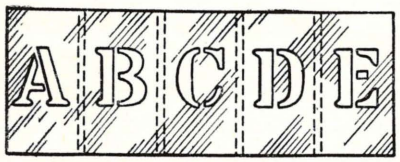


Fig. 202—Letter and number stencils are made of paper or brass

Here Is a Plan for Using a Stencil. Follow directions carefully.

1. Lay out the location for a stenciled border lightly in pencil so that it will be the same distance from the ceiling all the way. The location of other stenciled designs should be carefully planned.
2. Prepare the paint. If ordinary paint or enamel is used, it should be spread on a board, or other flat surface.
3. Wet only the ends of the bristles of the paint brush in the paint on the board. If the paint brush is too full of paint, the paint will run and spoil the design. It is well to test the brush on a piece of scrap wood or newspaper.
4. Locate the stencil and hold it firmly with one hand. If the stencil is moved, the design may be spoiled.
5. Stipple the paint in the openings of the stencil with the ends of the bristles. Do not attempt to stroke with the brush as for ordinary lettering or drawing. In so doing, the paint would get under the stencil and ruin the design. Use the least possible amount of paint.

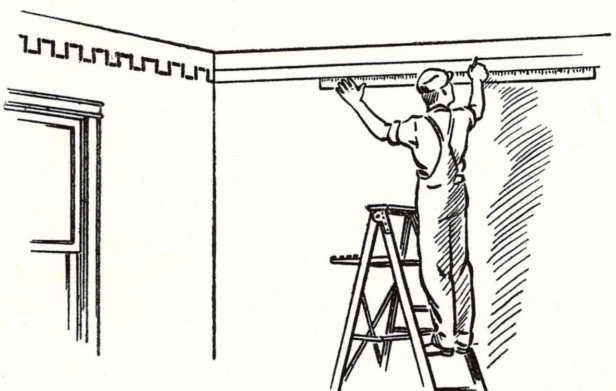


Fig. 203—The location of the stenciled border should be laid out lightly in pencil

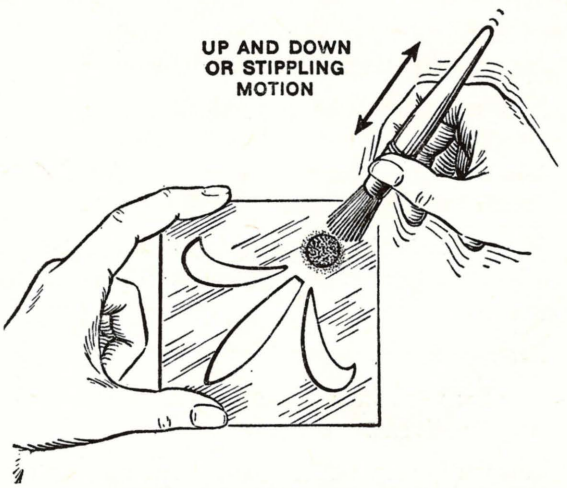


Fig. 204—Paint is applied through the holes in the stencil with the ends of the bristles

6. Carefully remove the stencil. If the paint is smeared, the entire design may as well be wiped off with turpentine and a rag, and applied again.
7. Carefully clean the back of the stencil if it is smeared with paint.
8. Complete the job and care for tools and equipment.

Was the Job a Success? Now Try the Job Test.

1. In stenciling, why should you apply paint with the ends of the bristles?
2. What is one difference between stenciling paint and regular paint?
3. How may scotch tape help in stenciling?

4. What kind of paint would you recommend for a basement wall?
5. Why should the paint be run onto the glass while painting a sash?

LACQUER FINISH

Lacquer is very desirable for small articles because it dries quickly, and leaves a smooth hard finish. It is often used for toys and some types of furniture. In factories it is applied with a spray gun, but in the home, it is generally applied with a brush. When purchasing lacquer, always be sure to get brushing lacquer, for the spraying lacquer dries too rapidly. Lacquer may be purchased in colors the same as paint, or clear, like varnish.

Lacquer is often used to preserve the natural finish on metal. When brass, copper and silver are exposed to the air they tarnish. Iron and steel rust. This can be prevented by applying a coat of clear lacquer after the surfaces have been finished as desired. If a person is to be successful in using lacquer, several things should be remembered.

1. Lacquer cannot be applied directly over old paint. The solvent used to thin the lacquer acts as a paint remover and softens the paint. This remains on the surface and will not dry.
2. Lacquer must be thinned with a special lacquer solvent. Turpentine or alcohol will not do the work.
3. Lacquer will not mix with paint.
4. Brushes used in lacquer must be cleaned with lacquer solvent.
5. Lacquer is very difficult to use on large surfaces because it dries too rapidly.
6. The fumes from lacquer are inflammable. For this reason, lacquer should be used out of doors, or in a place that is well ventilated.

STAINED FINISH

The purpose of stain is to give the desired color to wood. Things made of woods which have an attractive grain are often stained, thus bringing out the beauty of the grain. Common woods are often stained to imitate expensive woods. For instance, gumwood is often stained to imitate walnut. Birch, likewise, is stained to imitate maple and mahogany. Much of the furniture in use today has been brought to the desired color by the use of some form of stain. There are a number of different kinds of stain which the household mechanic should know.

Water Stain, which may be called a dye, is used by many of the furniture factories today. It penetrates deeply into the wood and does not fade. It is difficult for the home repairman to use because it soaks into the wood so rapidly that brush marks are apt to show and cause spots. Things small enough should be dipped into the stain and the surplus wiped off with a cloth.

Spirit and Chemical Stains are sometimes used by the expert finisher. These are difficult to apply and are often hard to get. The home repairman should be well informed before attempting to use them.

Oil Stain is the most popular stain for the home repairman because it is easy to apply and produces very good results. It is made of a pigment dissolved in oil which penetrates into the grain of the wood. Some stains, such as shingle stain, are made of creosote which preserves the wood to some extent.

Oil stain may be purchased in many shades and colors. It is always a good idea after buying stain to try it on a piece of scrap wood before applying it to the surface to be finished. If it is not the right color a change can be made before it is too late. The household mechanic can make his own brown, red, or yellow stain by mixing paint colors with asphaltum varnish or other mediums. Thin the varnish with turpentine, and add color a little at a time until the right shade is obtained. Reds and yellows are the most common colors added.

Paint Stain is sometimes used to color wood in bright paint colors, and pastel shades. It has the advantage of adding color, and at the same time allowing the grain of the wood to show. Some very attractive finishes may be made with oak and other open grained woods. Paint stain is made by mixing one part of paint with one part of turpentine and linseed oil.

NATURAL FINISH

A natural finish is obtained by finishing wood in its natural color. Wood which has enough color in its natural state is used for this purpose. Walnut, knotty pine, and selected pieces of gumwood and mahogany are commonly finished in this manner. Some form of protective coating such as varnish, linseed oil, or wax is generally used on the surface. These materials tend to darken the color of the wood but do not stain it. They also bring out the grain of the wood more clearly. To the wood finisher, and to the average person, a beautifully finished piece of wood is a work of art.

FILLER

Wood filler is usually applied to wood after it is stained although the filler itself is sometimes stained before being applied. The purpose of the filler is to fill up the pores in the wood so that the finish will be smooth and even when it is varnished. If the pores are left open, too many coats of varnish will be necessary. There are a number of different kinds of fillers on the market, but for the purpose of the home repairman only shellac and paste fillers are important.

Shellac is often used as a filler for woods which have a close grain, such as walnut, mahogany and maple. It is made from the secretion of an insect which feeds on a tree growing in southern Asia. This secretion is dissolved in alcohol. White shellac is used as a filler because it does not discolor the wood. However, orange shellac, which is cheaper, may be used for all general purposes. Orange shellac is used in outside painting for covering knots and pitchy spots. This is done to prevent the pitch from coming out, or bleeding, through the paint, causing brown spots to appear.

Paste filler is made of finely ground quartz rock, called silex, mixed with linseed oil. It is used on coarse grained woods such as oak and chestnut. The silex fills up the pores in the wood and produces a smooth even surface. Paste fillers can be colored to match the finish desired. It is thinned with benzine, and applied with a stiff brush. The benzine evaporates quickly, and the surplus filler, left on the surface of the wood should be wiped off across the grain with a piece of burlap, coarse cloth or excelsior.

Alcohol is a thinner for shellac, and should be used to clean brushes which have been used in shellac.

VARNISH FINISH

Varnish is used to produce a smooth hard finish on wood. It is made of vegetable gums and resins which are cooked with linseed oil and turpentine. Because varnish dries slowly, a clean and dry place should be provided in which to work. There are several different kinds of varnish. The kind to be used on a particular job depends upon the finish desired and the kind of wear it will have to stand. Quick-drying varnish is recommended for the household mechanic. It dries enough in about four hours that it will not collect dust. A longer time is required, however, if the finish is to be rubbed.

Floor Varnish is the kind generally used on floors. It makes a hard tough finish which will stand a great amount of wear.

Spar Varnish is made to withstand dampness. It is used on boats, and on furniture which is likely to have water spilled on it, but is not especially desirable if a high polish is necessary.

Rubbing Varnish is used on furniture where a high polish is desired. It will not stand wear like floor varnish or stand dampness like spar varnish.

Steel Wool is commonly used to rub down surfaces which have been stained or filled, or to remove the gloss after varnishing. No. 1 is coarse, and No. 3/0 is very fine. Steel wool may be purchased in most hardware stores by the package, usually a pound.

Pumice Stone is a finely ground stone used for polishing. It can be purchased in several grades of fineness. It may be used on a cloth dampened with water to rub down a varnished or enameled surface between coats. It may also be used on a cloth dampened with paraffin oil for a final rub down if a dull finish is desired.

Rottenstone is much finer and much softer than pumice stone. It is usually used to polish varnished surfaces, and leaves a dull glossy finish. It is used on a rag dampened with paraffin oil. Raw linseed oil will take the place of the paraffin oil if necessary.

Polishing Wax. Rubbed finishes are usually waxed. It helps bring out the luster. Wax may be purchased in liquid or paste form.

JOB NO. 48

HOW TO STAIN AND FILL AN ARTICLE MADE OF WOOD

Wood is often stained to bring out the beauty of its grain. The pores are then filled and the surface finished with a coat of wax or varnish. The household mechanic can use stain and filler very successfully. He must, however, do it properly in order to get a well finished job.

The Materials Necessary:

A can of the color stain desired. Oil stain is recommended because it is easy to use. This may be purchased in a variety of colors and shades.

A can of wood filler. Two kinds may be used, paste or liquid. Paste filler is recommended for open grained woods. Liquid filler is used on closed grained woods. The filler should be stained to match the color of the stain used.

Turpentine will be needed for thinning the stain, and benzine for thinning the filler.

The Equipment Necessary:

A clean can and brush will be needed for applying the stain and another for applying the filler. Coarse rags and excelsior are needed for removing the surplus stain and filler.

Here Is a Plan for Staining and Filling a Small Article Made of Oak Wood. Follow these instructions carefully.

1. Prepare the surface. It has often been said that preparing the surface is half of the job.
   (*a*) The surface must be well sanded. Sand the rough spots off with a medium sandpaper, about No. 1, or No. ½. Always sand with the grain of the wood. Sanding across the grain tears the fibers, and leaves dark scratches after the stain is applied. Give the surface a final sanding with No. 2/0, or finer before the stain is applied. Be particularly careful about the end grain. If it is not as smooth as glass, it will be very dark when stained. If it has been sanded properly, the end grain will show up beautifully.

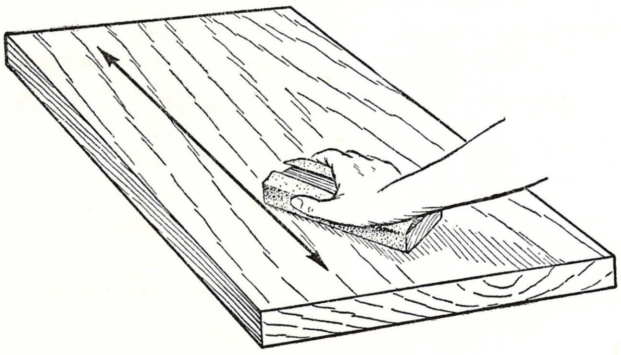


Fig. 205—Always sand with the grain of the wood

   (*b*) Remove all glue from the surface. Stain will not penetrate glue. Extreme care should be used when gluing that excess glue does not get on the surfaces to be finished. When it does, it must be wiped, scraped, and sanded off. Otherwise that spot will not take the stain. It is sometimes a good idea to do the staining before the parts are glued together. In doing this, the surfaces to be glued should not be stained, as glue will not stick to a freshly-stained surface.
2. Prepare the stain. Mix the stain as it comes from the can. Pour enough stain for the job into a clean container. Test for color on a piece of scrap wood. Thin with linseed oil or add darker stain until the right color is secured.

   Paste filler and oil stain are often mixed to use on open-grained wood. This saves making two applications and works very well. It is effective on close-grained woods if the mixture is not too thick and pasty.

   Varnish and oil stain are often mixed to use on close grained woods. The varnish acts as the filler in place of shellac which would otherwise be used. Do not try mixing shellac and stain, because they will not mix.

Fig. 206—Begin staining at the top and work down

3. Apply the stain. Brush with the grain the entire length of the surface. Begin at the top and work down. To prevent the end grain from becoming too dark, apply a small amount of stain and wipe it off immediately.
4. Remove the surplus stain with a cloth.
5. Care for brushes and equipment. The brush should be cleaned, dried, and put away for future use. Left over stain should be poured back into the can and sealed air tight for future use. Oily rags should be gathered and burned or placed in a safe metal container.
6. Allow the stain to dry. Usually about 12 hours is long enough.
7. Prepare the surface for filling. Simply brush off any dust which may be on the surface. Do not sand.
8. Prepare the filler. The thickness of the filler should depend upon the kind of wood to be filled. If the wood to be filled is coarse grained

the filler should be quite thick. If the wood is fine grained the filler should be very thin. Stain the paste filler to match the color of the wood. Mix enough benzine with the filler to suit the grain of the wood.

9. Apply the filler. The filler should be worked into the pores of the wood by brushing it across the grain.
10. Allow it to dry until the surface become dull. This will take from 15 to 20 minutes, depending on the amount of benzine used.

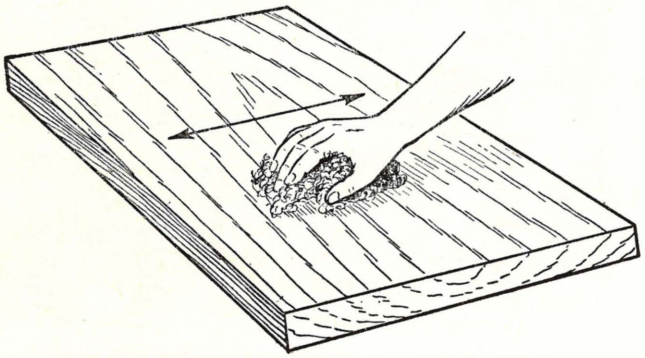


Fig. 207—Remove excess filler by wiping across the grain of the wood

11. Remove surplus filler. This must be done before the filler has had time to harden on the surface. Wipe the grain cross-wise with a coarse rag or wad of excelsior. Be careful not to remove the filler from the pores of the wood.

    Wipe the surface with a cotton cloth to be sure it is clean.
12. Clean the brushes and equipment.
13. Allow about 24 hours for drying.

Here Are Some Questions by Which You May Judge the Quality of Your Work.

1. Do any sandpaper scratches show on the surface?
2. Is the end grain too dark?
3. Did you mix the stain and filler?
4. What kind of filler would be used for walnut?
5. What effect does a glue spot have on stain?

JOB NO. 49

HOW TO APPLY A VARNISH FINISH TO WOOD

Varnish is applied to wood to produce a smooth hard finish. The wood may be stained or left in its natural color. The pores of the wood should be closed with a filler. Different polishes may be obtained by rubbing. The household mechanic can use varnish successfully if he is willing to learn a few things about it. He must follow instructions carefully, however, because a good varnish finish is difficult for the amateur.

Necessary Materials:

A can of varnish. The kind of varnish depends upon the kind of finish desired, and the place where the article is to be used.

Fine sandpaper will be needed for smoothing the surface. Fine steel wool is often desirable. Polishing oil, pumice stone, and rottenstone are necessary if a polished surface is desired.

Necessary Equipment:

A regular varnish brush is needed for applying varnish. It must have enough body to it that it will spread the varnish evenly over the surface, and not just skim over the top. See Enameling brush, page 49. Rags will be needed for dusting. A dust free room with a temperature of about 70 degrees is desirable for drying varnish.

Here Is a Plan for Applying a Varnish Finish to Wood. Read carefully!

1. Prepare the surface. Varnish may be applied to a surface which has been stained, or one which has been left natural. The pores of the wood should have been closed with wood filler or shellac. Several coats of varnish are necessary before an even surface can be secured.

   The surface to be varnished must be clean and free from dust. It must also be dry. Stain and filler raise the grain and also dust from the pores of the wood. This must all be sanded smooth with sandpaper or steel wool, No. 2/0, or finer. Do not sand the stain off so that the bare wood shows. Do not sand in the same room where varnish is applied.

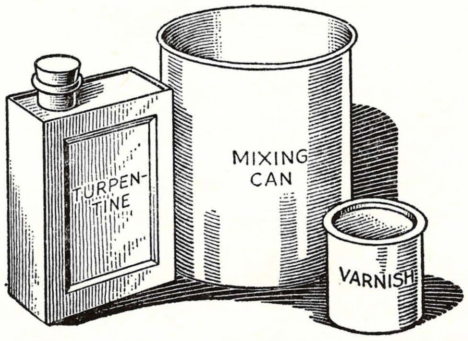


Fig. 208—Varnish may be thinned with turpentine for the first coat

2. Prepare the first coat of varnish. The varnish should be thinned with turpentine for the first coat. It is a good plan to follow the directions given on the can.
3. Apply the first coat of varnish. A warm, dust-proof room is needed in which to apply varnish. Brush the varnish out well.
4. Care for the varnish brush.
5. Allow at least 48 hours for drying. It may require longer. The outside may be dry, but underneath it may still be wet. It should not be touched until it is thoroughly dry.

Fig. 209—Varnish must be smoothed between coats with very fine steel wool or sandpaper

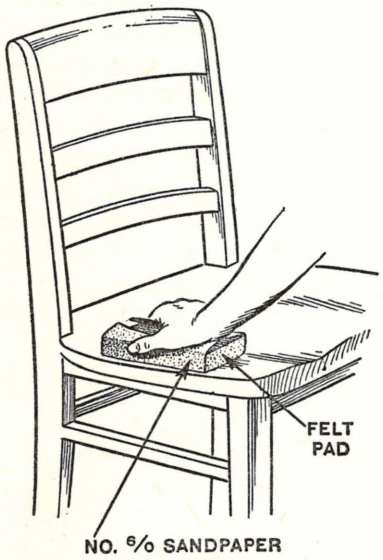


Fig. 210—No. 6/0 or 7/0 sandpaper should be used on flat surfaces.

6. Rub down the first coat. It is necessary to rub down the surface between each coat of varnish in order to get a good finish. The sandpaper removes dust particles which have risen to the surface, and dulls the finish of the varnish, making the next coat stick better.

No. 6/0 waterproof sandpaper is the best grade to use for this work. Wet the sandpaper, and wrap it around a felt, or soft rubber pad. Use No. 00 steel wool on round surfaces, such as table legs. Wipe the surface dry before applying the next coat of varnish.

Fig. 211—Brush with the grain when applying varnish

7. Apply the second coat of varnish. This should be applied as it comes from the can, without thinning. Take particular pains to apply an even coat.
8. Care for the brush, and burn the rags.
9. Allow it to dry. It is best to allow from two to four days. Be sure the varnish is absolutely dry before trying to polish it. Not more than two coats of floor varnish are usually necessary.
10. Rub down the second coat. Use very fine sandpaper or steel wool.
11. Apply the third and final coat of varnish. This will require even a longer time to dry than the

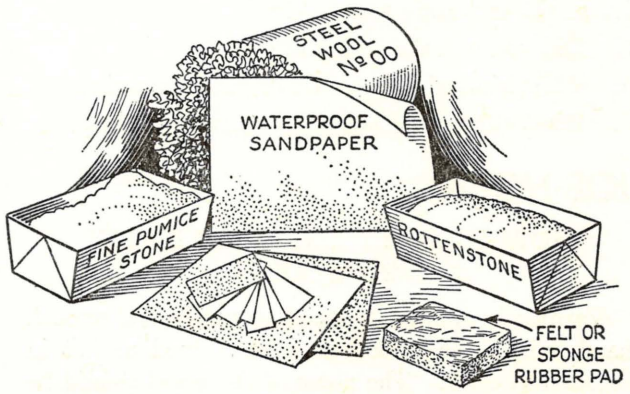


Fig. 212—Materials needed for rubbing down the surface

first and second coats. The brushes and equipment should be cleaned before storing.

Here Are Some Plans for Putting Several Different Finishes on a Varnished Surface. Use the one you like best.

I. *Dull Finish*

Wet a cloth or felt pad in water and dip in fine pumice. Sprinkle the varnish surface with water. Rub with the grain until a smooth surface is secured.

Wet another cloth or felt pad in polishing oil and dip in fine pumice. Continue to rub with the grain until all scratches and imperfections have been removed.

II. *Satin Finish*

First proceed as for the dull finish.

Then wet a cloth or felt pad in polishing oil and dip it in rottenstone. Rub the surface of the wood until the marks made by the pumice have been removed. Rottenstone is finer and less severe than pumice stone.

III. *Polished Finish*

First proceed as for a satin finish.

Dampen a piece of cloth in polishing oil and wring out the surplus. Rub the surface briskly until a polish appears. Then go over the surface briskly with a piece of dry cheese cloth.

Caution: Be absolutely sure that the cheese cloth is free from dirt or grit which would ruin the finish.

IV. *Waxed Finish*

Wax may be applied after any of the coats of varnish or after any finish. Do not apply it between coats of varnish, because varnish will not stick to a waxed surface.

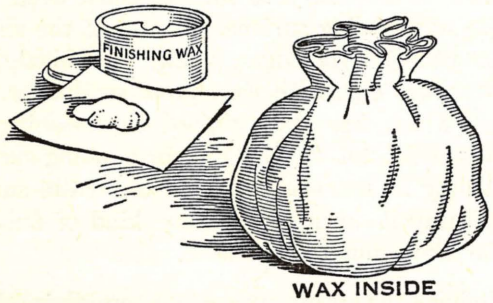


Fig. 213—Wax should be placed inside several thickness of cheese cloth

Use ordinary furniture wax. Place a small amount inside several thicknesses of cheese cloth, and apply to the surface. Allow ten minutes for drying and then polish briskly. (See Fig. 213.)

Apply a second coat and allow it to dry for an hour. Polish as before. The more it is polished, the better the finish will be. More wax will not help much.

How Does the Finished Job Look? Is it good enough that you might try on a better piece of furniture next time?

1. What kind of a finish does the piece have?
2. Are there any scratches on the surface?
3. How many coats of varnish were used?
4. Are the surfaces polished more on the sides than on the ends?
5. Why is varnish rubbed down between coats?

JOB NO. 50

HOW TO REMOVE OLD VARNISH

Old furniture in the home probably needs refinishing more often than new things. The household mechanic can learn to do a good job of refinishing if he has the patience to prepare the surface for the new finish. He should practice on something small and not very valuable. As skill is acquired, larger jobs may be tried.

Materials Needed:

A can of varnish remover will be needed to remove the old finish. This will not be necessary unless the old varnish is in poor condition. Sandpaper is needed for smoothing rough surfaces. Benzine and rags are useful for cleaning the surface.

Equipment Needed:

A can and brush are needed for applying the varnish remover. A putty knife, a scraping tool, some coarse steel wool, a stiff brush, and some rough cloth are necessary for removing the old varnish.

Here Are Some Suggestions for Removing the Old Varnish and Preparing the Surface for a New Finish.

1. Inspect the surface. Is it badly checked or marred? If so, the old varnish should be removed.

   Note: If the finish seems to be quite smooth, not discolored or badly checked, the rough surface may be sanded down and washed with a solution of sal soda and water. Then the new finish may be applied over the old.
2. Apply varnish remover. A generous coat should be applied with a brush, and allowed to stand

until the varnish softens. This will require from 5 to 15 minutes. Keep the remover covered when not in use.

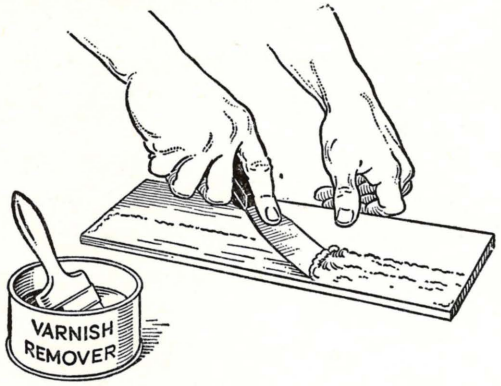


Fig. 214—Removing the old varnish after it has been softened with a varnish remover

3. Remove the softened old varnish. It should be scraped off with a putty knife. A brush, steel wool or a rag may be needed on carved or curved surfaces. Apply another coat of varnish remover if the varnish does not all come off the first time.

   Caution: Great care should be observed not to damage the wood with the scraping tools.
4. Clean the surface with benzine. This is necessary in order to take off the wax left by the remover. This wax will prevent the new coat of varnish from drying.
5. Finish as for a new job. It may be necessary to restain the wood. This can be decided only when the old finish is removed.

How Successful Were You With This Job? These questions may tell you.

1. Is the old finish entirely removed?
2. Are there any scratches on the surface?
3. Has the surface been cleaned with benzine?
4. Why should the surface be cleaned with benzine?
5. Why is rottenstone used in finishing varnish?

JOB NO. 51

HOW TO REPAIR DAMAGED FINISHES

Scratches or stains on varnished surfaces are the worry of every housewife. Anyone who can repair them will certainly earn her sincere thanks. Repairing scratches and stains is not an easy thing to do. Neither is it always successful. It takes a great amount of skill to make the surface as good as new. But the household mechanic, with a little instruction, can usually make them less noticeable. It would be a good idea to practice on an old piece of furniture before attempting a job on a good piece.

There are a number of things which may happen to varnished surfaces which discolor or mar them. In order to make discussion easier they are divided into classes.

1. Scratches Which Do Not Damage the Wood

In this case, only the varnished finish is damaged. Four remedies are suggested. Try them in the order suggested. If the first one does not work, try the next.

(*a*) If the scratch is small, try rubbing the meat of a black walnut into the scratch. The oil from the walnut meat will not remove the scratch, but it will make it less noticeable.

(*b*) Wrap the small end of a toothpick tightly with a piece of cotton. Dip this in turpentine and carefully fill the scratch. Be careful not to get any turpentine on the surrounding surface.

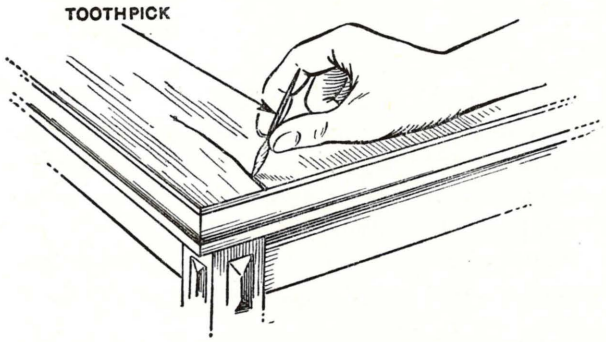


Fig. 215—The scratch may be filled with turpentine or shellac

(*c*) Wrap a small piece of cotton tightly around the small end of a toothpick as before. Fill the scratch with white shellac. Apply as many coats as necessary to fill the crack even with the surrounding surface. If any of the shellac has run over the edges, it may be rubbed down after it is dry, with waterproof sandpaper, No. 7/0 which has been dipped in polishing oil. Be careful not to spoil the surrounding surface. It may be necessary to sand the entire surface to bring it down to the same kind of finish as the area around the scratch.

(*d*) Refinish the entire surface. A scratch is seldom bad enough for this kind of treatment.

2. Scratches Which Have Damaged the Wood Underneath the Varnish.

(*a*) Go to a paint store and buy some stick shellac, the same color as the finish to be repaired.

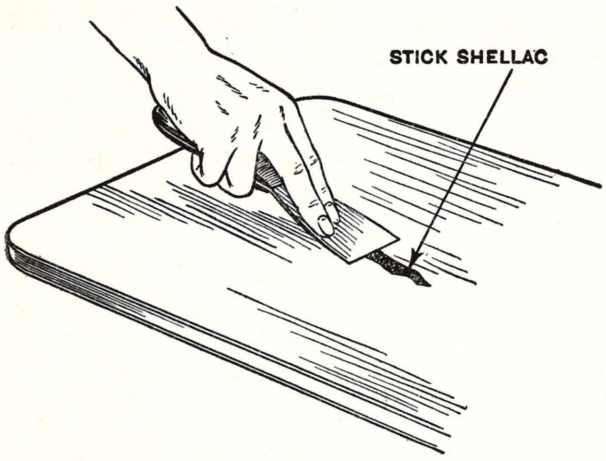


Fig. 216—Stick shellac should be smoothed even with the surface with a warm putty knife

(*b*) Melt some of the shellac into the scratch with a hot piece of metal, until the crack is filled.

(*c*) Finish by scraping the surface very carefully with a knife, and sandpapering with No. 7/0 sandpaper. Be very careful not to mar the surrounding surface.

3. Stains Caused By Liquids

The surfaces of dressers and tables are frequently stained by liquids which have been spilled on them. The varnish usually turns a white color. These spots are extremely difficult to remove. The surest thing is to have the surface completely refinished. However, here is a remedy for the household mechanic to try. If it fails, the surface can still be completely refinished.

(*a*) Sandpaper the spot smooth, or until the stain has been removed, and for a small area around the spot. Use about No. 2/0 sandpaper.

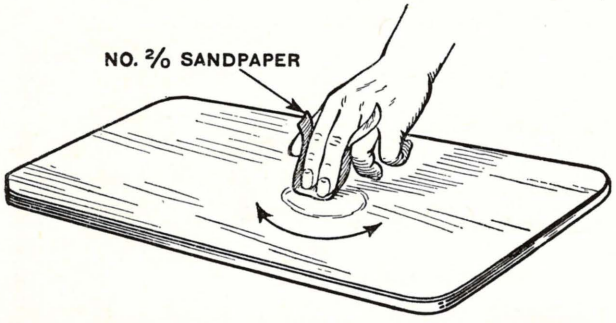


Fig. 217—Sandpaper the spot smooth with No. 2/0 sandpaper

(*b*) Very carefully apply a coat of varnish, brushing out the edges very thinly.

(*c*) After this has dried, sandpaper and apply a second and third coat of varnish, as instructed in Job 49. The second and third coats should cover a smaller area than the preceding coat.

(*d*) Attempt to tone the newly-varnished surface down with the surrounding surface with No. 7/0 sandpaper and polishing oil, or with rottenstone and oil. If this is not satisfactory, sandpaper the entire surface smooth and revarnish.

(*e*) Another method is to rub the stained spot with a rag dampened in alcohol.

4. Burns

Cigarette burns on furniture are not uncommon. Use any of the above methods which seem to be practical. If only the varnish is damaged, the spot may be treated as for a stain. If the wood has been charred, stick shellac may be used after removing the charred wood with a chisel. Another method is to have an expert cabinetmaker graft another piece of wood in place of the damaged wood.

PENETRATING FINISHES

During recent years a new type of penetrating finish has been developed. It is made of penetrating oils and waxes, and is sold under various trade names. Many claims have been made for this type of finish. In order to do this type of finishing, several materials are necessary.

The First Coat

The first coat is a penetrating oil which penetrates very deeply, and seals the pores of the wood. This prevents the absorption of moisture, and therefore prevents warping, rotting, and expansion. Wood is often treated with this sealer before it is sent out to be used in the construction of houses.

The Second Coat

The second coat is a penetrating wax, which further seals the pores of the wood, and provides a lustre after being rubbed with fine sandpaper.

The Third Coat

The third coat is a polish. It may be rubbed to a nice lustre with fine sandpaper, about No. 6/0.

Some Advantages of Penetrating Finishes

1. Penetrating finishes may be applied with a rag. No brush or special skill is necessary. The important thing is to apply a generous amount, and cover the entire surface.
2. Dust spots do not show. While penetrating finishes should not be exposed to dirt and dust while drying, dust does not leave spots on the

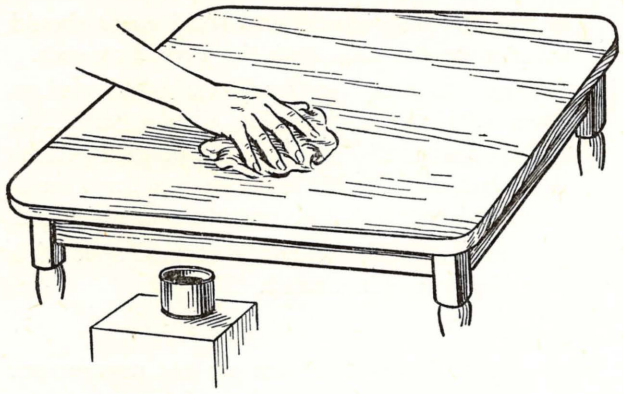


Fig. 218—Penetrating finishes may be applied with a rag

finished surface. They are polished off with No. 6/0 sandpaper.

3. Laps do not show. A particular spot may be finished without refinishing the entire surface.
4. Scratches are easy to repair. Since the finish is in the wood rather than just on the surface, scratches may be sanded off with sandpaper.
5. The sealer may be mixed with stain to produce a stained finish, as well as a natural finish.
6. The sealer may be used as a water repellent for cement walls, etc.
7. The sealer may be used as an undercoat for paint.

REPAIRING FURNITURE BEFORE REFINISHING

Furniture which needs refinishing also often needs repairing. Joints come unglued, seats come apart, and screws pull out. Some of these repairs can be made by the household mechanic without sending them to the repair shop.

JOB NO. 52

HOW TO REGLUE A CHAIR

The chair is the most common piece of furniture to need regluing, probably because it is the most abused. The joints which come unglued are usually those where the rungs are fastened to the legs, where the legs are fastened to the seat, or where the back is fastened to the seat. These can usually be reglued with materials found in the home.

Materials Necessary:

Glue is always necessary. Any standard brand of ready-mixed glue may be used. Casein glue holds better since it resists dampness, but it is more difficult to use. Pieces of clothes line or sash cord will be needed for drawing the joints together. Several blocks of wood will probably be needed.

Here Are Some Suggestions for Regluing Chairs.

1. Pull the loose joints apart. Do not take any more of the chair apart than is absolutely necessary in order to get at the loose joints.

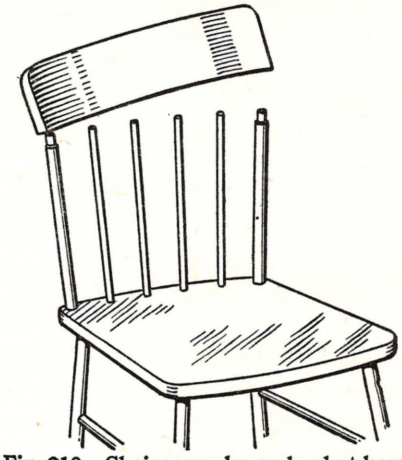


Fig. 219—Chairs may be reglued at home

2. Scrape off the old dry glue. Do not remove any of the wood, because it is probably too small as it is.
3. Prepare the tenon for regluing. This may be done in several ways.
4. Apply glue to the end of the rung regardless of the type of fastener used. Be sure that both ends are ready to glue at the same time.
5. Place the rung in the hole and force it in place. A mallet may be used on the leg of the chair for this purpose. Be sure to place a block of wood on the surface to be struck with the mallet to avoid damaging the finish.
6. Draw the joint tight with a rope tightener, and leave for twenty-four hours to set.

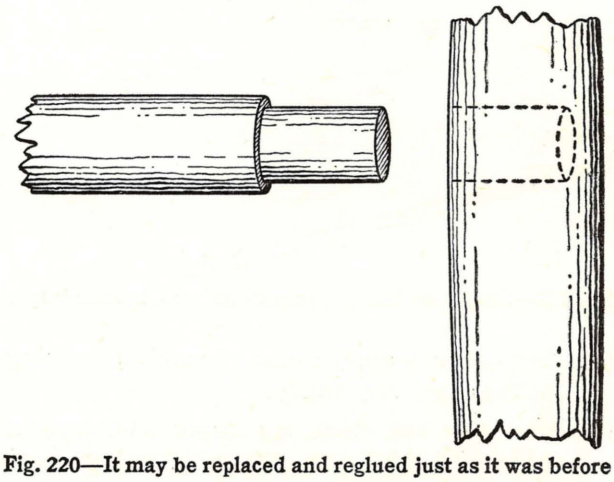


Fig. 220—It may be replaced and reglued just as it was before

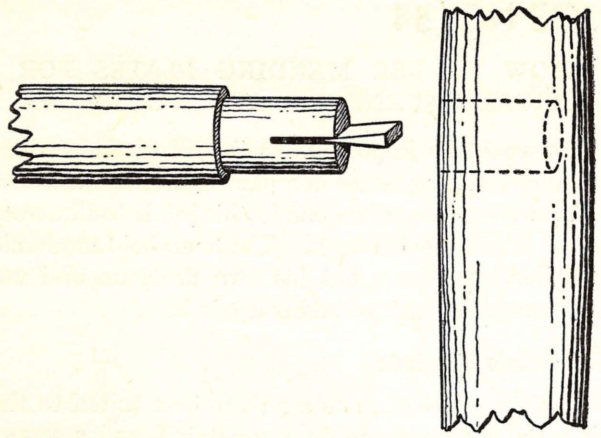


Fig. 221—A slot may be sawed in the end about one half inch deep, and a hardwood wedge cut the same length that will spread the end when the tenon is driven in

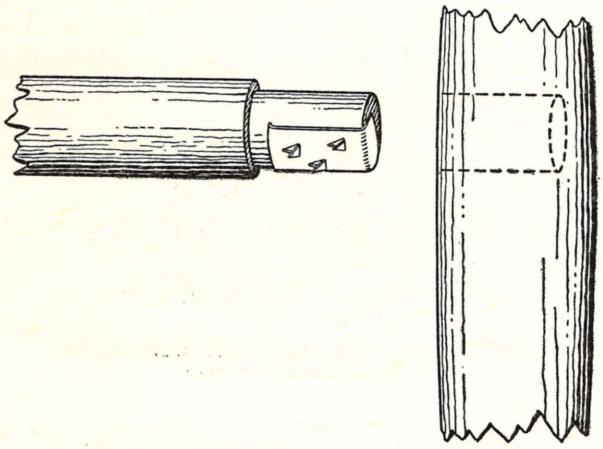


Fig. 222—Patented fasteners may be purchased at the hardware store

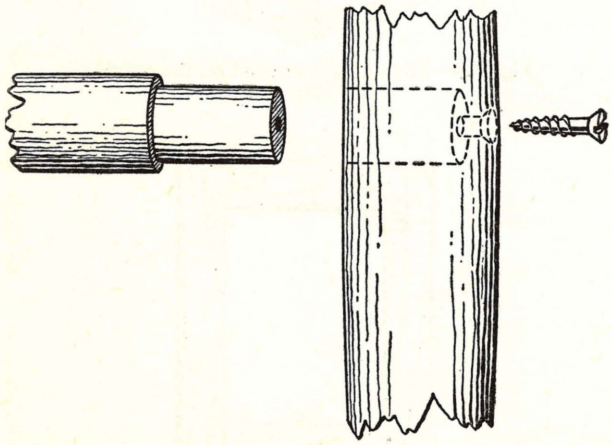


Fig. 223—A screw may be driven through the leg and into the end of the tenon. Countersink the screw and fill the holes with plastic wood

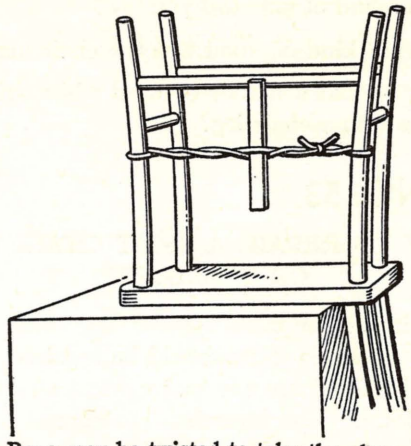


Fig. 224—Rope may be twisted to take the place of a clamp for holding glue joints

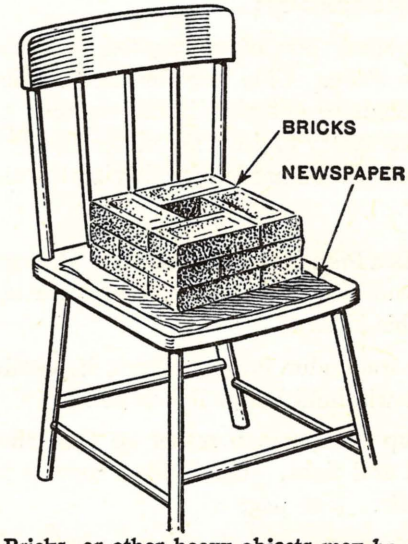


Fig. 225—Bricks, or other heavy objects may be piled on a chair seat when gluing the legs to the seat

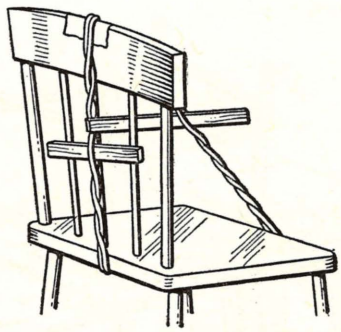


Fig. 226—When gluing the back, a rope may be run under the seat and twisted with a stick. Be sure to tighten both places to keep the back straight

Have You Actually Repaired a Chair? Was It a Success?

1. What part of the chair did you reglue?
2. What type joint did you use?

3. What kind of glue did you use?
4. Of what kind of wood was the chair made?
5. Why should a mallet be used when driving the rungs into a chair leg?

JOB NO. 53

HOW TO REPAIR A SPLIT CHAIR SEAT OR TABLE TOP

A chair seat or table top, or any other piece of furniture which is split, should be repaired before it is refinished. There are many ways of doing jobs of this kind. The household mechanic is usually looking for a way which will not take too much time.

Materials Necessary:

Get a small box of corrugated fasteners at the hardware store. Glue may be used if the crack is open enough to get glue into. A rope, or clamps may be necessary to draw the pieces closely together. A hammer will be needed for driving the corrugated fasteners.

Here Is a Plan for Doing the Job. Use good judgment because this job sheet cannot cover all possible jobs of this kind.

1. Run some glue into the crack if possible. The joint will hold better if it is glued.
2. Clamp the parts together so that the joint is good and tight. Use twisted rope as for gluing a chair. (See page 81).
3. Drive corrugated fasteners across the joint, about six inches apart.

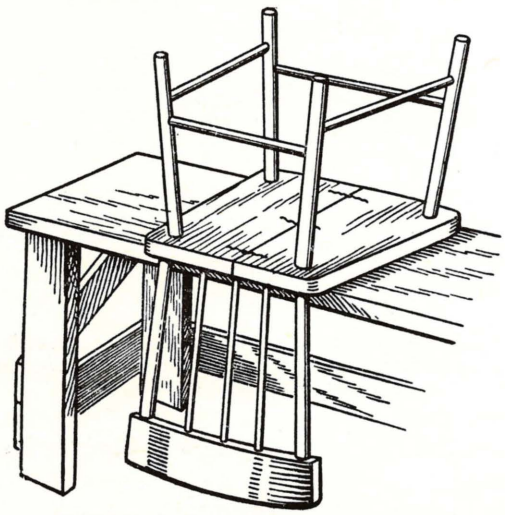


Fig. 227—A split chair seat may be repaired with corrugated fasteners

JOB NO. 54

HOW TO USE MENDING PLATES FOR BROKEN FURNITURE AND WOODWORK

It would be impossible to list all of the various used of mending plates in repairing broken furniture. About all that can be done in this job is to illustrate some of the possible uses. The household mechanic will have to figure out his own problem, and use the one which will serve his needs best.

Materials Needed:

Get the type of mending plate best suited to the job, the necessary screws, a small drill and a screwdriver for driving the screws.

Here Are Some of the Kinds of Mending Plates, and Some of Their Uses.

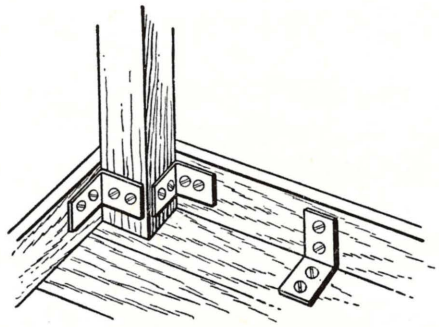


Fig. 228—The angle iron used for fastening the leg or apron to a table

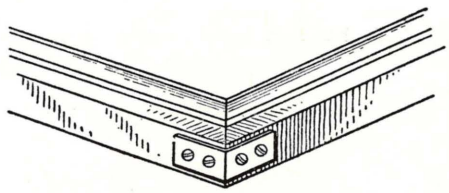


Fig. 229—The angle iron used on the outside of a picture frame

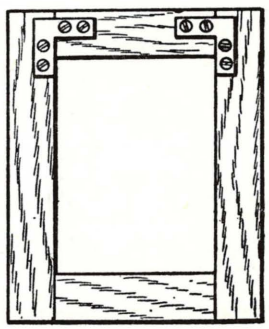


Fig. 230—Corner plates used on the inside of a cabinet door

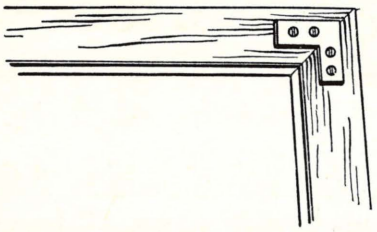


Fig. 231—Corner plate used on back of a picture frame

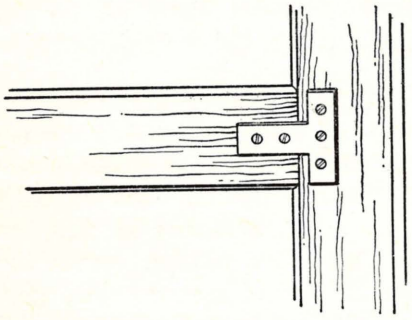


Fig. 232—The T-plate used on the center rail of a paneled door

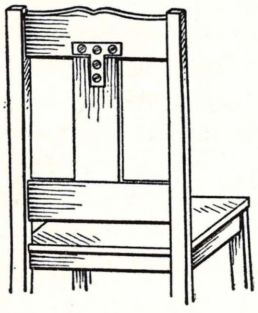


Fig. 233—The T-plate used on the panel of a chair back

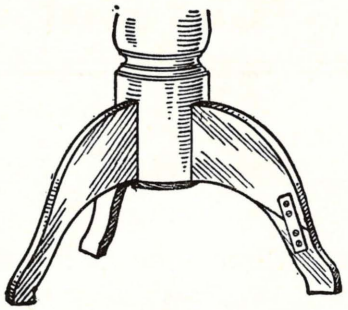


Fig. 234—The straight plate used on the broken leg of an end table

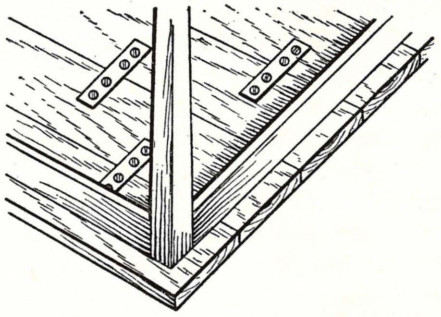


Fig. 235—The straight plate used on the under side of a table top which is split

See Metal Job No. 17.

Care of Electric Appliances

Chapter 4

MOST people are interested in electricity. Some are interested because they like to work with it. Others are puzzled and like to find out how it works. Whatever these special interests may be, it is necessary for everyone to know about the use of electricity in the home. With the large number of electric devices in common use today, it is plain to see that the person who knows the most about them will get the most from their use.

Electricity is one of the great conveniences in our modern homes. It is safer for lighting than gas, oil lamps, or candles. When used in motors for power, it is much better than gasoline or steam. However, there are many hazards connected with the use of electricity if the wiring is wrongly installed, or if the electric devices are carelessly handled. *Only minor repairs to the electric system or equipment should be attempted by the home repairman.* These repairs may include such tasks as replacing a blown out fuse, overhauling a door bell system, repairing the cords on electric appliances, or cleaning and oiling electric machines. *Extensions or alterations to the permanent wiring should be done only by a licensed electrician.* Most communities protect themselves from fire and other hazards, by requiring that all wiring must pass a very rigid inspection when installed.

In order that one may become a more intelligent consumer of electricity in the home, directions for making some experimental wiring on panels will be given. A knowledge of some of the basic principles of electricity, as well as a little practice in using the tools and materials of an electrician, are necessary if the home repairman is to be at all successful. It is also suggested that one learn as much as possible about the principles involved in the various electric appliances used in the home before attempting to work on any of them.

SOURCES OF ELECTRICITY

Electricity is a form of energy which seems to be present everywhere. It cannot be seen by man, but it can be harnessed to do many useful things. Man has found that in order to use this electric energy, he must generate it by the use of chemicals, or machines.

The Dry Cell

The dry cell is one of the most familiar means of providing electric energy by the use of chemicals. Energy supplied in this way is suitable for toys and small appliances where the current does not have to be very strong. Dry cells are made in a number of sizes. The standard size, when at full strength, sets up a current of about $1\frac{1}{2}$ volts across the terminals. Volts, or voltage, means the electric pressure which forces the current through the wires. Smaller dry cells, commonly known as flash-light cells, produce a lower voltage.

When a voltage greater than $1\frac{1}{2}$ volts is desired, two or more dry cells may be wired in series. This means that the center binding post of one is wired to the outside binding post of the next. Two cells wired in this manner would produce 3 volts, three would produce $4\frac{1}{2}$ volts, etc. In flash lights, two, or sometimes three cells are used in series.

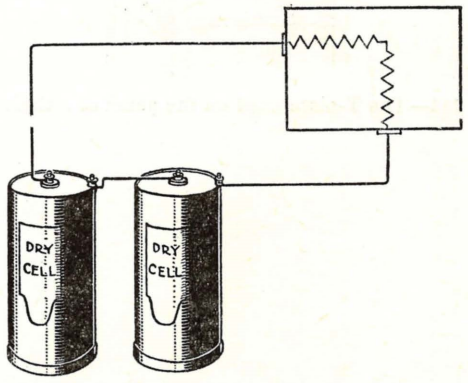


Fig. 236—Two dry cells when connected in series will set up a voltage twice as large as one cell, or about 3 volts

Dry cells may also be wired in parallel. This is not commonly done, since it does not increase the voltage. It does make them last longer than one cell. By wiring the cells in parallel, is meant connecting all the center binding posts on one wire, and all the outside binding posts on another.

The construction of a dry cell is quite simple. The container is a zinc can, covered with cardboard. The black stick in the center of the container is made of carbon. Around this stick of carbon is a

wet chemical substance. The chemical takes the active part in generating the electric pressure. The dry cell gets it name, not because the contents are dry, but because they will not spill, as will the contents of the storage battery. The top of the dry cell is sealed air tight with sealing wax to prevent the chemical from drying out. If the chemical becomes dry, the dry cell loses its strength.

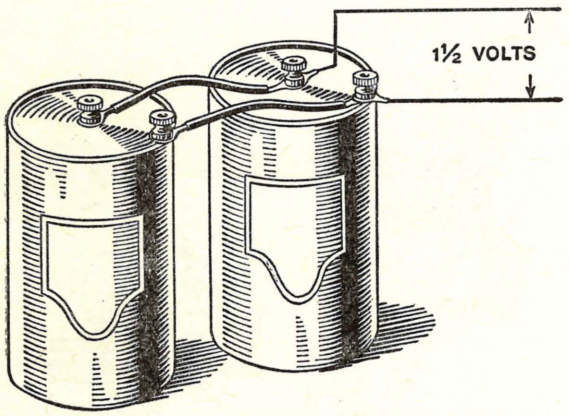


Fig. 237—Two dry cells wired in parallel will set up a voltage the same as one cell, or about 1½ volts

The dry cell does not furnish a current of electricity unless the carbon and zinc binding posts are connected. When these are connected, either with or without an electric appliance, the chemical takes energy from the zinc container and carries it to the carbon stick. From this point the electric energy or pressure passes through the wire and back to the zinc container. This is known as a circuit. This process continues until the connection is broken or the cell is worn out. It might be well to remember that the carbon binding post is called the positive (+) terminal; the zinc, the negative (−) terminal.

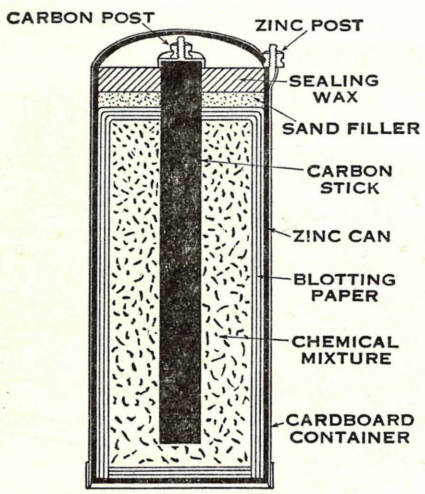


Fig. 238—Section view of a dry cell

When the cell has become worn out, the zinc container will usually be found to have holes in it, because the chemical has used the zinc to generate electric energy. The dry cell may be brought to life again for a short time by drilling a hole through the sealing wax and pouring water or vinegar into the hole. Another way is to set the dry cell in a pan of water and heat it. There is no way to permanently restore a worn-out cell.

ELECTRIC CIRCUITS

An electric circuit is said to be complete when the wires carry the current from the positive terminal of a dry cell through an electrical device, and back into the negative terminal of the dry cell. When an unbroken path from one terminal to the other is provided, the circuit is said to be closed.

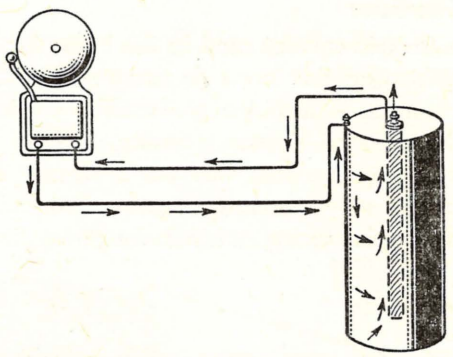


Fig. 239—An electric circuit provides an unbroken path for the current from the positive terminal, through the appliance, and back to the negative terminal

When this path is broken at some point, the circuit is said to be open. In order for an electric device to operate, it is necessary that this circuit be closed. As soon as the circuit is broken, the device ceases to operate, because electric current will not flow through an open circuit. For this reason, a broken wire in an electric device makes the device useless until the break is repaired.

The Storage Battery

The storage battery, sometimes called a wet battery, is another means of providing electric current by chemical action. A battery is composed of two or more electric cells combined in a single unit, as shown in Fig. 241. In a storage battery these cells contain two sets of lead plates in a chemical solution. The battery is charged by direct

current from a generator. Electric energy is stored up in the cells to be used as needed. This is the type of battery used in the automobile. The automobile battery produces about 6 volts or electric pressure with three cells, which is equal to four dry cells wired in series. Home lighting plants use storage batteries to store up electrical energy, but the cells are connected in series to produce voltage higher than that used in the automobile battery.

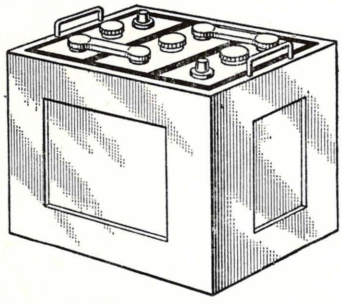


Fig. 240—The storage battery must be charged with a direct current generator

The Generator

The electric current used in the home for lighting lamps, heating flat irons or toasters, and running small motors, is machine generated. Ordinarily it has 110 volts of electric pressure. Home lighting plants operate on less, but use a storage battery. An electric stove usually requires 220 volts, and requires special wiring run from the power line to the

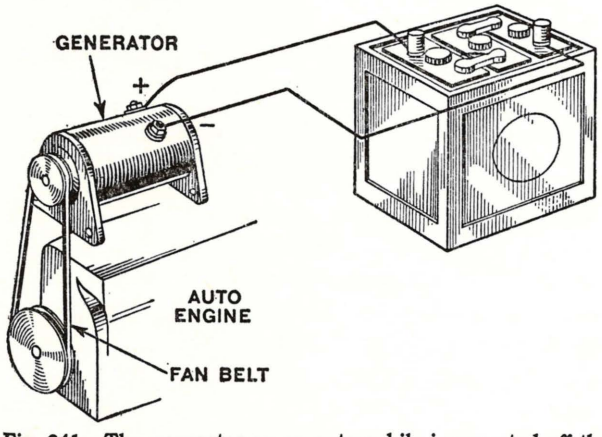
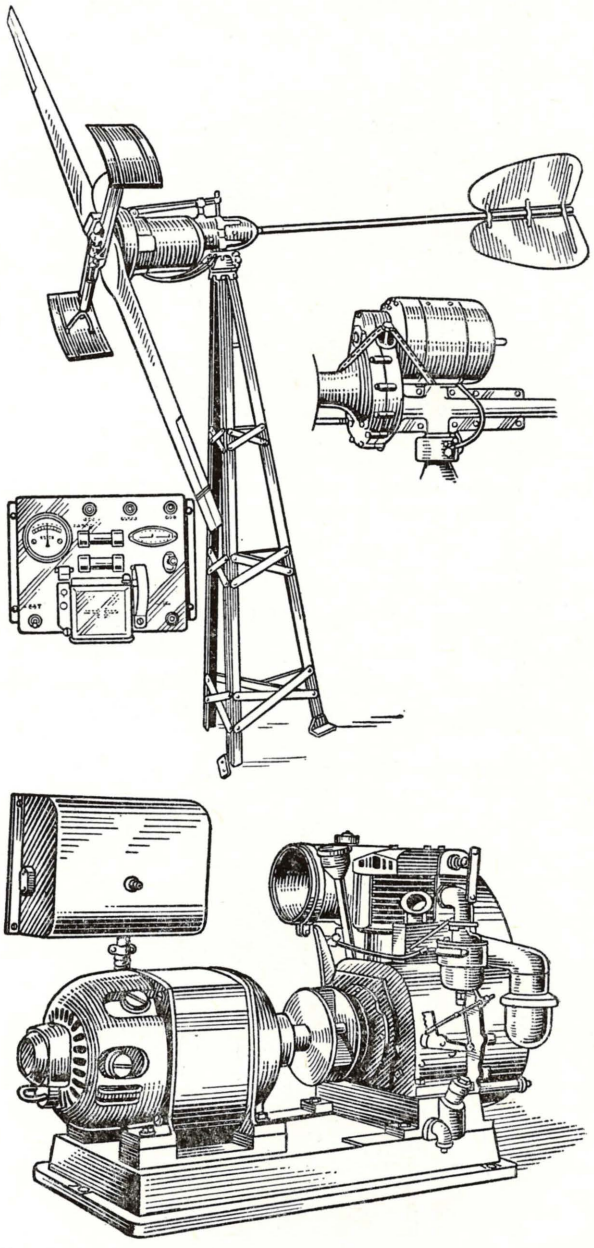


Fig. 241—The generator on an automobile is operated off the fan belt and charges the storage battery which furnishes the current for the ignition and lighting systems

house. The current used in factories is usually much higher in voltage than that used in homes; therefore this voltage is very dangerous for the inexperienced person to handle.

When a generator is used, some kind of power is necessary to turn the generator. In the automobile, the generator is often turned by the fan belt. In home lighting plants, it may be operated by wind power, or by a gasoline motor. Electric power companies often use water power to turn their large generators because it is cheap. When water power is not available, it is often necessary to use steam engines.



Figs. 242–243—Home lighting plants generators are usually operated by wind power or a gasoline motor which charges the storage batteries

A. C. and D. C. Current

The household mechanic should be familiar with the fact that there are two kinds of electric current

commonly used in homes. One is alternating current, and is commonly called A. C. The other is direct current, and is commonly called D. C. It is impractical to attempt to give a thorough explanation here, for that would require some very technical study. However, a few comparisons should give the household mechanic all the information he needs to use it intelligently.

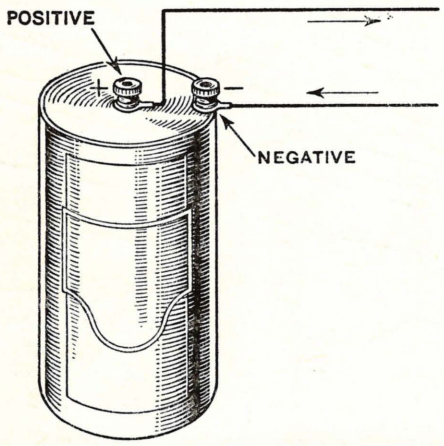


Fig. 244—Direct current, as from a dry cell, always flows in one direction, from positive to negative

Electric current from a dry cell or a storage battery is called D. C. and always flows in one direction, from positive to negative. There is always a positive and negative wire, and for D. C. motor-driven appliances, these wires must not be interchanged. The electric current used in the automobile and in most home lighting plants is D. C. Storage batteries are charged by a D. C. generator, and the current is used from the storage batteries. However, D. C. current is sometimes used direct from the generator. D. C. current is the only kind of electric current available in some communities.

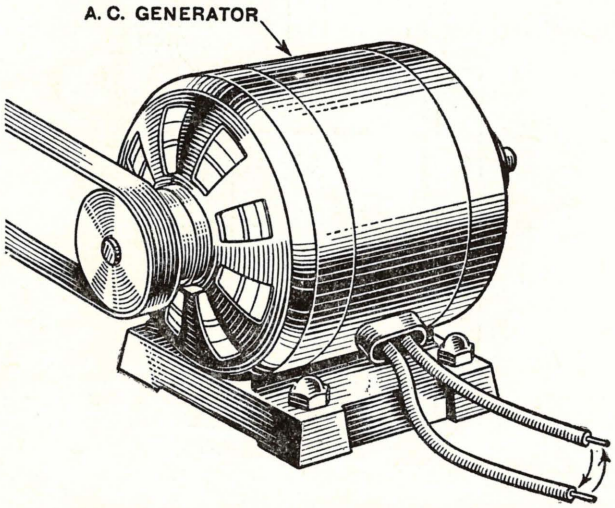


Fig. 245—A. C. current alternates from one wire to the other in its direction of flow

For home use, A. C. current is much more common than D. C. current. It is called alternating current because the direction of the flow of current alternates from one wire to the other. There is no negative or positive wire. Alternating current is always generated by a machine generator, and not by means of chemicals.

How To Identify A. C. and D. C. Appliances

It is very important for the household mechanic to be able to distinguish between A. C. and D. C. appliances, especially when buying second hand appliances. If an A. C. appliance is used on D. C. current, the wiring in the appliance will be burned out. Appliances built for D. C. current will not work on A. C. current. When people move from one locality to another, they often ruin their old appliances by plugging them into a different kind of current than they were built for. A very wise thing to do would be to find out what kind of current is used in the new locality, and dispose of all electrical equipment which cannot be used, before moving. The market will be flooded with the kind you now have when you arrive because nobody will be able to use it. Electric lights and heating appliances may be used on either A. C. or D. C. current. Electric razors, and a few special appliances are often wired to use either A. C. or D. C. because they are normally carried from one locality to another.

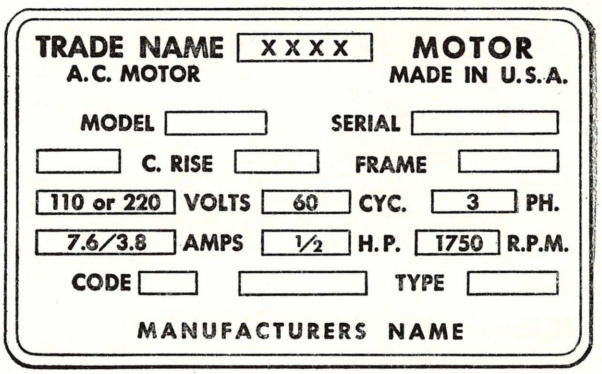


Fig. 246—The specifications plate for an electric motor contains much information useful to the household mechanic

As a matter of fact, most new motor driven appliances have universal type motors, which means they can use either D. C. or A. C.

Before using a new electric motor, or any appliance driven by a motor, look for the specifications plate.

This is a metal plate usually attached to the frame of the motor or appliance by the manufacturer. On this plate is stamped the information which the household mechanic should know. The kind of current which should be used in the appliance is always stated.

Appliances other than those driven by motors have this information stamped on them in a place where it can be seen, but where it will not mar the beauty of the appliance.

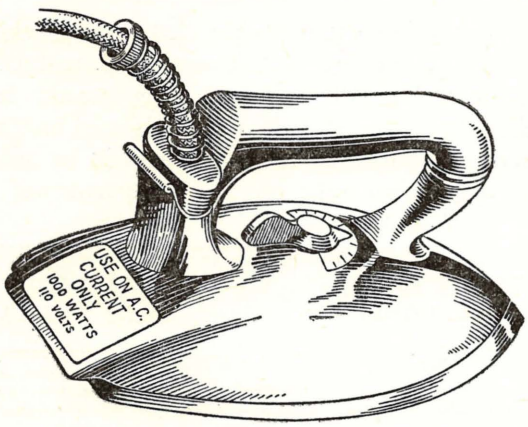


Fig. 247—Users information is stamped on all electric appliances

Voltage

It has been stated before that voltage means the electric pressure that forces the current through the wires and appliances. Some appliances use a higher voltage than others because it takes more power to operate them. A door bell, for instance, requires from $1\frac{1}{2}$ to 6 volts. It should be used with a source of electricity having an electric pressure of that amount. If a door bell were connected directly to the 110 volt house current, the coil in the bell would be burned out. Likewise, if a motor built for 110 volts were connected to a 220 volt line, the wiring in the motor would be burned out.

How To Determine Voltage

Manufacturers of electric appliances are very anxious that their products give good service. For this reason they place the information the user needs on the appliance. The voltage mark is always given. It should be found on the specifications plate of motor-driven appliances. It may be found elsewhere on other appliances. (See Figs. 246 and 247.)

Transformers

Power companies send electric current out from their power stations on high-tension lines. The voltage on these lines is much too high to be used in homes. In order to make the electric current safe for home use, transformers are used to reduce the voltage to 220 or 110 volts. One of these transformers will be found in every neighborhood using electric current. Wires will be found running out from these transformers to individual homes.

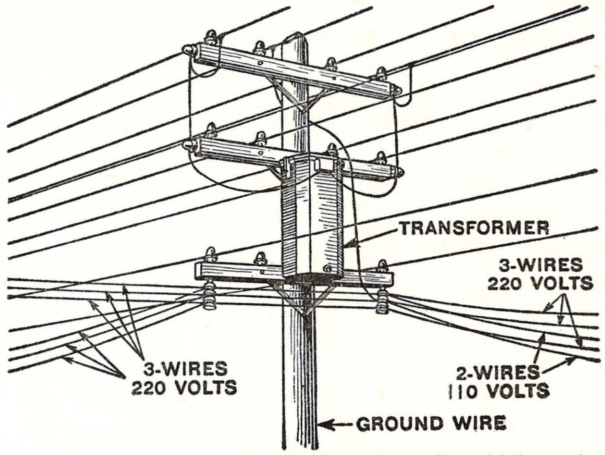


Fig. 248—Transformers reduce the voltage from high tension power lines so that it is safe for home use

Many of the older homes have two wires running from the transformer or power line to the house. This means that no appliance using over 110 volts

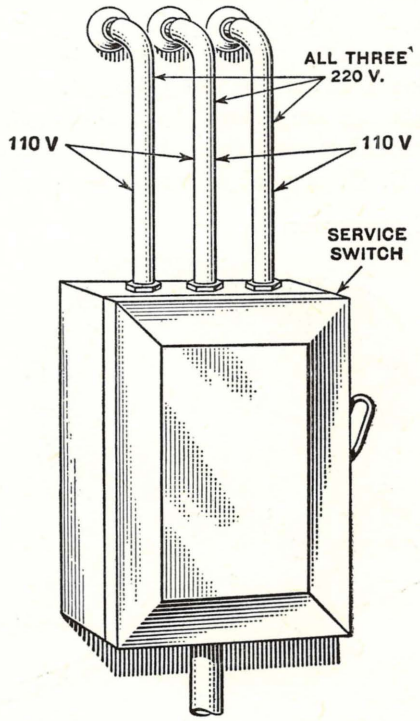


Fig. 249—Either 110 volts or 220 volts are available when three lead-in wires are used

may be used. During recent years the electric stove has become popular for home use, and uses 220 volts. To avoid doing a special wiring job when the householder buys an electric stove, power companies usually run three wires from the transformer or power line to the house when the house is built. This means that 220 volts are available at the service switch. When 110 volts are desired, only two of the wires are used. See Fig. 249. When 220 volts are desired, all three wires are used.

Most household appliances operate on 110 volts. There are a few which require less. For these appliances, another transformer is used to reduce the voltage as necessary. A transformer is usually wired into the electric circuit of the house for the door bell. Transformers for electric toys are usually made so that they may be plugged into a wall outlet safely by children. The household mechanic should not

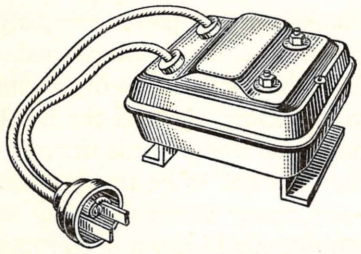


Fig. 250—A bell transformer reduces the house lighting current for use in ringing a door bell

attempt to connect a transformer to the house wiring. He may, however, attach a wall plug to the transformer and plug it into a wall outlet.

A TEST ON SOURCES OF ELECTRICITY

1. The dry cell container is made of _____.
2. The stick in the center of a dry cell is made of _____.
3. The zinc binding post is called positive / negative (cross out one).
4. One dry cell produces _____ volts of electric pressure.
5. Three dry cells wired in series produce _____ volts of electric pressure.
6. Two dry cells wired in parallel produce _____ volts of electric pressure.
7. A battery is composed of two or more _____.
8. Electricity is mechanically generated by a _____.
9. Do we get D. C. from a dry cell? _____.
10. What is used to reduce 110 volt electric current to be used for running a toy train? _____.
11. What would happen if an A. C. electric appliance were plugged in on D. C. current? _____.
12. What kind of electric current is used in your home? _____.
13. What is the voltage of the current used in your home? _____.
14. What is the common voltage for household appliances? _____.
15. The automobile storage battery generates / stores up electric energy. (cross out one).
16. Can an electric stove be used in a house with three lead-in wires? _____.
17. Is a complete circuit necessary for an electric motor? _____.

CONDUCTORS AND INSULATORS OF ELECTRICITY

Conductors

Electricity is carried from place to place by means of materials which will allow electricity to pass through them. These materials are called conductors of electricity.

Resistance

Some conductors permit electricity to pass through them more freely than others. The one that allows the electric current to pass through more easily is said to offer little or no resistance. Conductors that offer greater hindrance to the flow of electric current, are said to have a high resistance. Resistance then, may be defined as the amount of opposition a conductor offers to an electric current passing through it.

All metals are conductors of electricity. Copper is the most widely used because it has low resistance and is cheap compared with other good conductors. Iron is not generally used as a conductor of electricity because it has greater resistance than copper. A higher voltage is required to force an electric current through iron than is required to force the same amount of current through a copper conductor of the same size.

Safety Precaution

There are many materials which are conductors of electricity that are apt to be dangerous. For instance, water, under certain conditions, is a conductor of electricity. Anything which is soaked with water will carry electricity. For this reason, standing on wet floors, or wearing wet clothing is extremely dangerous while working with electricity. The earth is, to a certain extent, a conductor of electricity, as it contains both water and minerals.

One of the most common hazards around the home is a light switch near the bath tub, or other plumbing fixture. Water in the bath tub is in contact with the drain pipe, and forms a perfect ground. If a person standing in the tub touches the switch, he is apt to receive a very severe, or even fatal shock,

if the fixture is defective. The same thing might happen if one hand were in the water in the wash bowl. Many persons have been killed by electric shock using electric appliances while sitting in the bath tub.

Copper wire is the most convenient means of carrying electricity from place to place. It is made in many forms and sizes. In general, there are two kinds of wire, the solid and the stranded. The solid is made of a single wire, and is used where it does not have to be moved. If solid wire is bent or moved a great deal it breaks. Stranded wire is made up of a number of smaller wires, all twisted

Fig. 251—Turning on a light switch with one hand in the family wash may cost you your life

together. It is very flexible, and is used for extension cords or appliance cords, since it will stand a great amount of bending before it breaks. All electric wire is covered with some kind of insulation.

Insulators

An insulator of electricity is a material which will not allow an electric current to pass through it. The purpose of an insulator is to control the path over which electricity will travel. An insulated wire or device which carries electric current is thus made safe for use. If the insulation becomes worn off a wire, there is danger of the electric current starting a fire. A person using an electric device which is not properly insulated may receive a shock or burn.

Glass, rubber and porcelain are the most commonly used insulators of electricity. Rubber is used on electric wire, and porcelain is often used as a support for fastening wires. Dry cotton and silk also act as insulators. Several layers of dry paper are effective if the voltage is not too high. In some homes, electric wires are run through tubes called conduits. This eliminates the danger of the insulation wearing off the wires. New types of wiring are constructed to eliminate this danger. See Figs. 254 and 255.

Safety Precaution

Electric power wires carrying high voltage sometimes break and fall to the ground or on buildings or fences. This often happens during storms when the ground is wet. Not only is the electric wire itself dangerous, but the fence or other objects it touches may be carrying the current. A person coming in contact with any of these objects is apt to be fatally injured. He will at least be paralyzed by the electric current and unable to help himself. Anyone attempting to rescue another person from this kind of a situation is also in great danger. Do not try it unless you are insulated. Someone should call the power company and have the current shut off. In the meantime, dry rubber gloves, a dry rubber hose, or a dry rubber boot are good to use in pulling wires off the helpless person. Paper, wood, or cloth, are insulators only if they are dry, and they are apt to be damp during a storm. If they are dry, many layers should be used. Start artificial respiration and call a doctor as soon as the person has been moved a safe distance from the wires.

Wiring In The Home

The household mechanic should be familiar with the materials used in wiring the home, and the importance of having it installed and cared for properly. Thousands of fires cause damage to homes each year because the electric wiring was not installed properly, or because inferior materials were used. Many of these fires are the result of the lack of proper care. Many are the result of someone who knows too little trying to do too much, in order to save a few dollars. It is very important that the household mechanic should know just how far it is safe for him to go in the care and repair of household electric wiring and equipment.

The permanent household wiring should always be installed by a licensed electrician. He knows what is safe and what is dangerous. He is bound by his license to install all wiring in accordance with the rules laid down by the National Electric Code. The licensed electrician has the proper tools and equipment for doing all kinds of wiring. He also uses only materials approved by the Underwriters Inspection Bureau. The household mechanic should never use electric wiring unless it has the official band-clip of the Underwriters Inspection Bureau

on it. This means that the type of wire has been inspected by the Bureau and approved for use in house wiring.

Fig. 252—The Underwriters Inspection Bureau allows its label only on electric wire which is safe to use

Electric wires are sometimes run through metal or plastic conduit. Conduit has been replaced during recent years by other types of wiring. However, there are some instances where it is still used. Conduit should always be used where the electric wires from the power line enter the house. It may be used on basement walls or places where unprotected wires are apt to be damaged. Conduit is used when running wires inside of a concrete wall. The household mechanic should leave all conduit work for the licensed electrician.

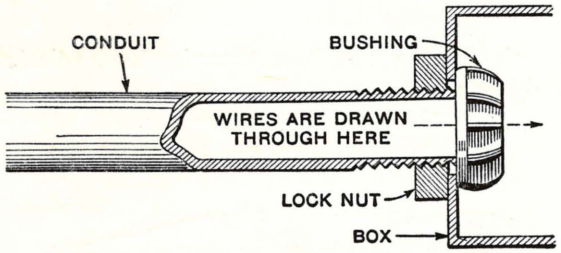


Fig. 253—Connection between conduit and box

Sizes Of Wire

Wire used for 110-volt house wiring is made in several sizes. No. 14 is the size most commonly used. However, with the increase in the use of electric appliances, many electricians are now using No. 12, which is larger. A larger wire will carry more of a load without heating, and costs very little more to install. Annunciator wire is made in size No. 18. It is smaller than No. 14, because it only carries 6 volts. It is used for wiring door bells, etc.

Kinds Of Wire

There are three kinds of wire commonly used for installing the permanent wiring in a house. Armored cable is used in places where protection is necessary. Non-metallic cable is used within the walls of a house for carrying the electric current to the fixtures and outlets. These cables may contain two, three, or four wires, each wire having a different colored wrapping. Ordinary rubber-covered wire is used in some communities for house wiring. Notice that all wiring used for permanent wiring is solid wire. Permanent wiring should always be installed by a licensed electrician.

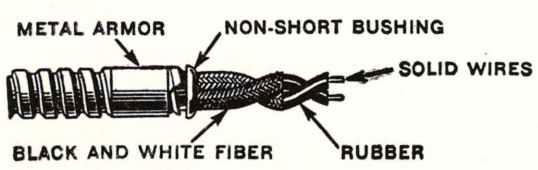


Fig. 254—Armored cable

The household mechanic should be familiar with lamp and appliance cord, the kind used for attaching fixtures and appliances. It is made of stranded wire and is commonly called cord. Twisted lamp

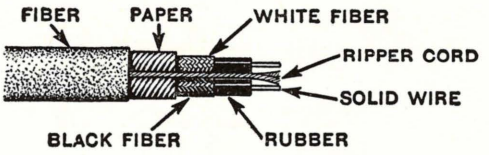


Fig. 255—Non-metallic cable

cord is not used much since the newer silk or rubber covered cord was placed on the market. All lamp cord is covered, first with an insulating layer of rubber, and then with an outside covering of either

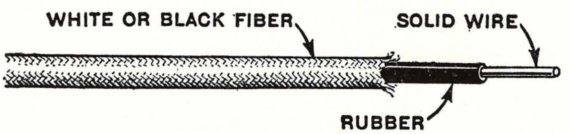


Fig. 256—Rubber covered wire

cotton, silk, or rubber. Appliance cord is heavier than lamp cord, and has an additional layer of asbestos insulation. This is necessary because heaters, toasters, etc., require more electric current than lamps, and the wires are apt to become hot. These wires can safely be installed by the household mechanic if he is willing to abide by the rules given in this chapter.

Annunciator wire is often called bell wire, and it is used for connecting door bells and all low-voltage

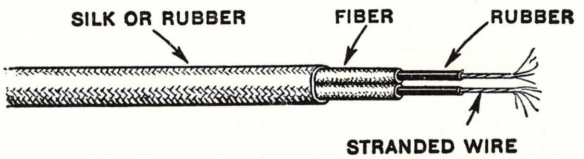


Fig. 257—Lamp cord, either silk or rubber covered

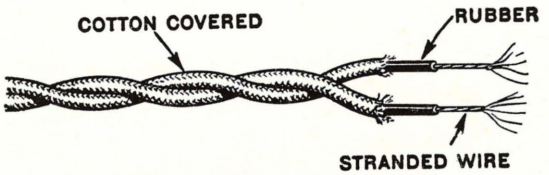


Fig. 258—Twisted lamp cord

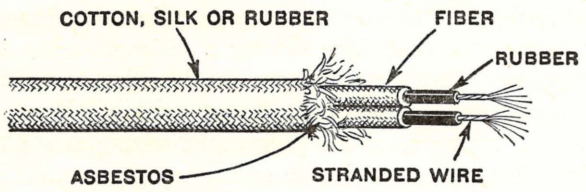


Fig. 259—Heavy duty appliance cord

appliances. It is covered with a treated cotton or fiber insulation. The insulation does not need to be very heavy, because the voltage is low. Do not, however, make the mistake of using this wire for ordinary appliances. The insulation is not heavy enough to prevent arcing or short circuits.

A TEST ON CONDUCTORS AND INSULATORS

1. An electric conductor is any material which will allow _____ _____ to pass through it.
2. The commonly used conductor is copper / iron / aluminum (cross out two).
3. Copper has a higher / lower resistance than iron. (cross out one).
4. An insulator is a material which will / will not allow an electric current to pass through it. (Cross out one).
5. Three good insulators are _____, _____, and porcelain.
6. Water in a bath tub is a good conductor / insulator of electricity.
7. What insulating material is most common on electric wires? _____.
8. Is it safe to use paper to pull live electric wires off from a person in contact with them?
9. Permanent house wiring is done with solid / stranded wire.
10. Permanent house wiring should be installed and repaired by the _____ _____.
11. Lamp and appliance cords are made with stranded wire so they will not _____.
12. Should annunciator wire be used for door bells? _____
13. Appliance cord is insulated with asbestos in addition to the regular insulation because _____.
14. Armored cable is used in places where _____ is needed.

Electric Splices

Splices are used as little as possible in electric wiring. Carelessly made splices are responsible for many fires and accidents. However, it is sometimes necessary to splice electric wire, and the household mechanic should be able to do it correctly. The following three jobs explain how to do all of the splicing the household mechanic will have occasion to use.

JOB NO. 55

HOW TO MAKE THE WESTERN UNION SPLICE AND THE BRANCH TAP

The Western Union splice and the branch tap may be used by the household mechanic in wiring door bell systems and other low voltage appliances. The Western Union splice may also be used as a temporary repair to appliance cords, but should not be considered permanent.

Materials Necessary:

Insulated electric wire, solder, rubber tape and friction tape.

Equipment Necessary:

A pair of pliers, a knife for removing the insulation, and soldering equipment.

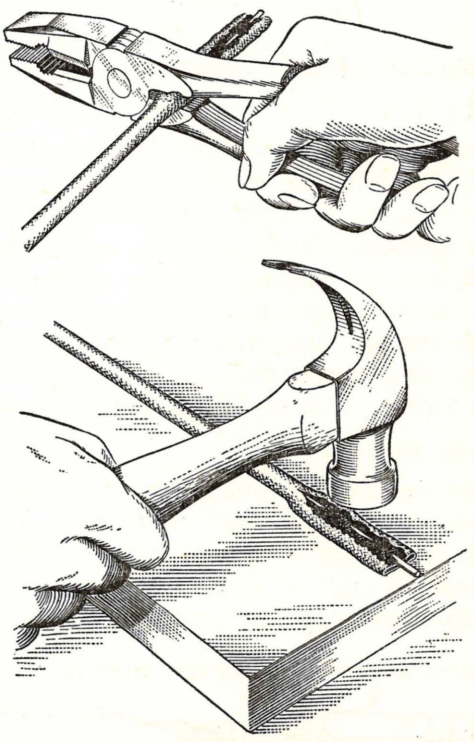


Fig. 260—The insulation on solid or stranded wire may be crushed between the handles of a pair of side cutting electricians' pliers, or by pounding with a hammer. Be careful not to nick the wire.

Here Is a Plan For Making the Western Union Splice and Branch Tap. Be sure to follow instructions carefully.

1. Remove the insulation. At least three inches on the end of each piece will be necessary for making the Western Union splice. For the branch tap, remove about one inch from the unbroken wire, and about five inches from the end of the wire to be attached.

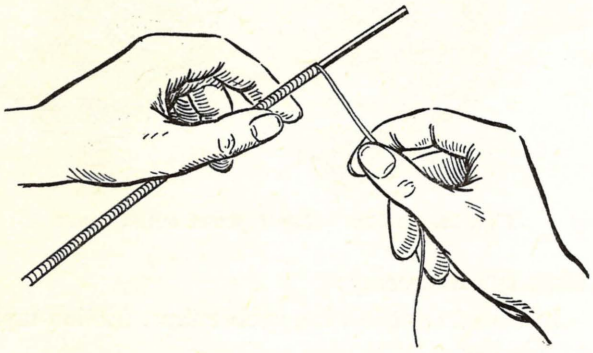


Fig. 261—The insulation may be unwound from bell wire with the fingers

2. Scrape the wires bright and clean with a knife. This is especially important. A dirty wire will not make a good connection and cannot be soldered easily.

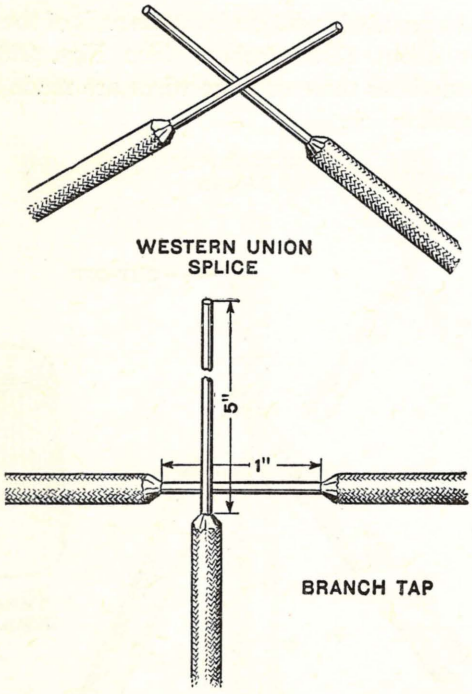


Fig. 262—The wires should be scraped bright and clean with a knife, and the insulation neatly tapered

3. Make the splice as illustrated. All splices must be tightly and closely wound.

This is the Western Union splice, used for joining the ends of two wires in a line.

The branch tap is used for joining a wire to a line.

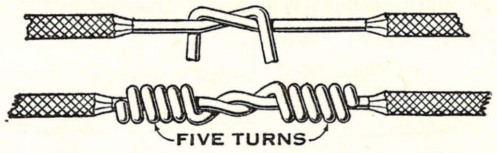


Fig. 263—The procedure in making a Western Union splice

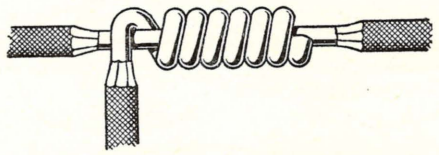


Fig. 264—The branch tap is usually made with about 7 turns around the line wire

4. Solder the splices. All splices should be soldered in order to prevent the joints from becoming loose. However, splices in bell wiring circuits are seldom soldered.

Apply paste flux to the splice, and hold a heated and well tinned soldering copper on the under side of the splice. As the splice becomes hot, feed the solder into the turns of the wire from above. A torch may be used instead of a soldering copper. Then the solder may be melted directly into the turns of the splice.

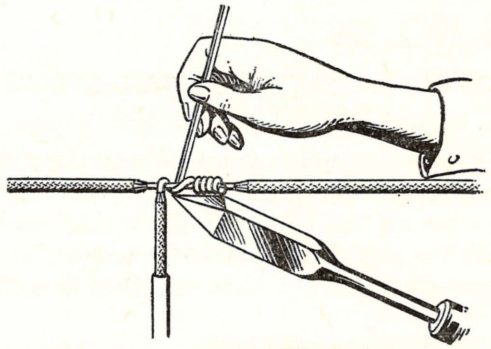


Fig. 265—Soldering a splice with a soldering copper

Warning—Stop! Do the splices have the required number of turns? Are the splices well soldered? These things must be inspected before covering the splice with insulating tape.

5. Tape the splices. All splices should be covered with insulation equal to that of the rest of the wire.

First, wind the splice tightly with rubber tape to take the place of the rubber insulation.

Then, wind the splice a short distance each side of the joint with friction tape to take the place of the fiber insulation.

Did You Succeed in Doing a Good Job? Unless you checked the work step by step, there is no way of seeing how well the splice was made without removing the tape. Is the splice neatly taped? Poorly made splices will cause trouble later; sometimes very serious trouble.

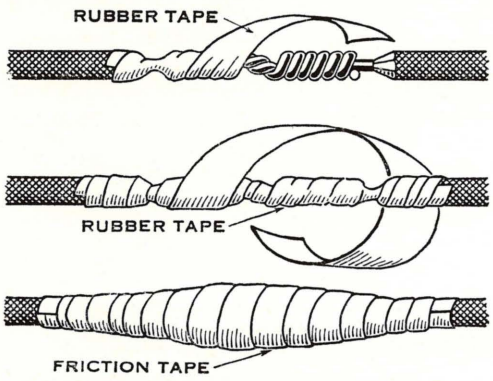


Fig. 266—All splices must be carefully taped

Job Test

1. Why should a splice be soldered?
2. Why should a splice be taped?
3. What tool was used to break the insulation?
4. Why is it important to clean the wires well?
5. The Western Union splice should have at least _____ turns on each side.

JOB NO. 56

HOW TO MAKE A PIGTAIL SPLICE

The wiring code for most localities requires that there shall be no splices between boxes for 110-volt house wiring. The pigtail splice is the one used most often in the box. The household mechanic will use the pigtail splice in wiring lamps and other fixtures. It is desirable that all splices be soldered,

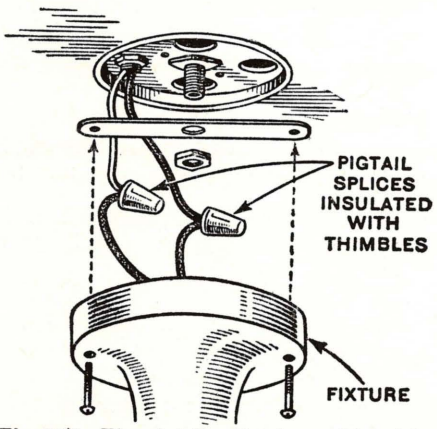
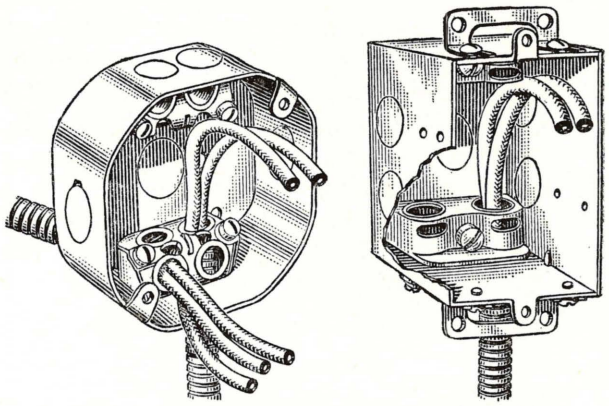


Fig. 267—The pigtail splice is used in wiring fixtures and in boxes

but this is not often done in the case of the pigtail splice because it is protected by the box. All splices should be insulated as well as the rest of the wire.



Figs. 268 and 269—Two types of outlet boxes

Materials Necessary:

Insulated electric wire, rubber tape, friction tape, or thimbles.

Equipment Necessary:

A pair of pliers, and a knife for removing the insulation.

The Following Instructions Will Be Helpful in Making the Pigtail Splice. Follow them carefully.

1. Remove the insulation from the ends of the wires, for about three inches. (See Figs. 260-261.) Sometimes three or more wires are made into a pigtail splice.

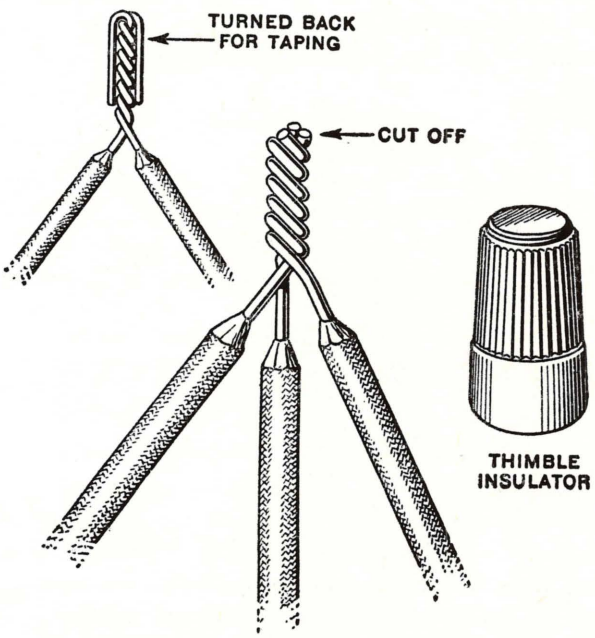


Fig. 270—The ends of the wires in a pigtail splice may be turned back for taping or cut off for a thimble insulator

2. Scrape the wires bright and clean. This is important. A dirty wire makes a poor connection.
3. Twist the wires together in a neat spiral. If tape is to be used, the ends can be bent back down over the splice. If a thimble is to be used, the wires should be cut short enough that the thimble covers all of the bare wire.
4. Insulate the splice with tape or a thimble insulator. In some cases both tape and the thimble insulator are used. Whatever is used, should fit tightly so that there is no danger of it coming off.

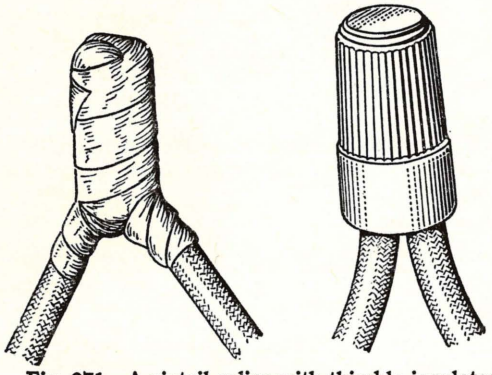


Fig. 271—A pigtail splice with thimble insulator

Did You Succeed in Doing a Good Job? A good splice is very important. If the wires should become loose they are apt to cause trouble. If the insulation should come off so that both bare splices should touch, fuses would be blown out, and possibly fires might be started.

Job Test:

1. Are pigtail splices ordinarily soldered?
2. Explain why this is true.
3. Why should wires be scraped clean for splicing?
4. Where are pigtail splices usually used?
5. Can you imagine why splices are not permitted between boxes?

JOB NO. 57

HOW TO SPLICE AN APPLIANCE CORD

A defective appliance cord is dangerous and should not be used. When the insulation is worn off or the wires are broken, the cord should be replaced. It sometimes happens, however, that the cord cannot be replaced immediately, and the old one has to be repaired. Even though the cord has been repaired, it should be replaced as soon as possible.

When the insulation has been worn off the wires of an appliance cord, each wire may be insulated with rubber and friction tape temporarily. (See Fig. 272.) When the wires are broken, the cord must be spliced.

Materials Necessary:

An appliance cord, friction tape, rubber tape, solder, and paste flux.

Equipment Necessary:

A pair of pliers, a knife, a pair of scissors, and soldering equipment.

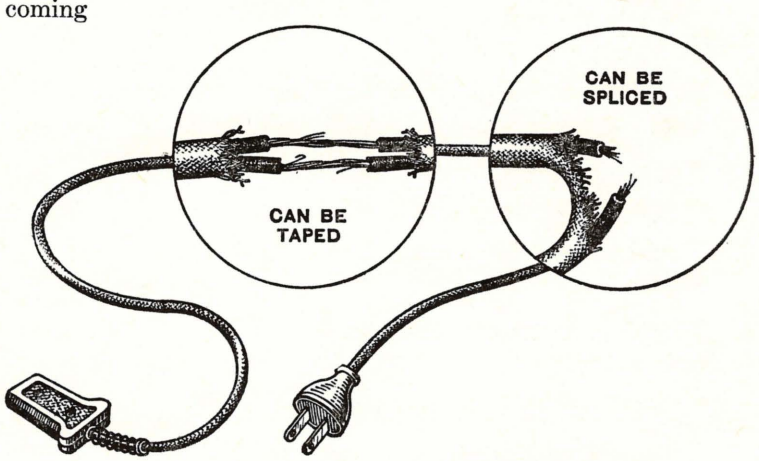


Fig. 272—A defective appliance cord should be discarded or repaired temporarily

Here Is a Plan for Splicing an Appliance Cord. Be sure to follow instructions carefully.

1. Cut the cord clear through at the point where the wire is broken.
2. Remove the outside covering a distance of about eight inches from each end.
   Caution: Do not remove the rubber insulation.
3. Cut about four inches off one of the wires in each cord. This is done in order that the splices will not come opposite each other.

Fig. 273—One wire in each end is shortened in order to stagger the splices

4. Splice the wires. Make regular Western Union splices. (See page 93.)
5. Solder the splices. Since appliance cords are made with stranded wire, splices will not hold unless soldered. (See page 93.)

Fig. 274—An emergency repair on an appliance cord

6. Insulate the splices with tape. Each wire should be wound with several layers of rubber tape. Both wires may then be bound together with friction tape. Remember, this is only a temporary repair. Get a new cord as soon as possible.

Test:

1. How long should a spliced appliance cord be used?
2. Would a lamp cord be spliced in the same manner as an appliance cord?
3. Would a splice in stranded wire hold unless soldered?
4. Why do you avoid putting the splices opposite each other?
5. Why is each wire insulated with rubber tape?

ELECTRIC FITTINGS

In a previous paragraph it was shown that a complete circuit through an electric appliance is necessary in order to make it work. Electric wires alone would complete the circuit, but it would be very unhandy, and in most cases, extremely dangerous to connect the wires every time an electric appliance is used. To overcome this situation, many kinds of electric fittings have been invented. These fittings include many varieties of switches, plugs, outlets, and sockets. Some of these fittings may be installed or replaced by the household mechanic, while others should be left to the licensed electrician. However, the household mechanic should be familiar with all of them.

Switches

A switch is a mechanical device for opening and closing an electric circuit. Once a switch is installed, the wires need not be touched until the switch is worn out. Switches are made in many different styles, each of which is suited for a particular use. But in general, all of these styles may be classified into four main types, namely, push button, spring, mercury, and knife switches.

The Push Button

The *push button* is used for low voltage electric devices such as the door bell. It closes the circuit as long as the button is held down, and opens the circuit when the button is released. (See Fig. 275.)

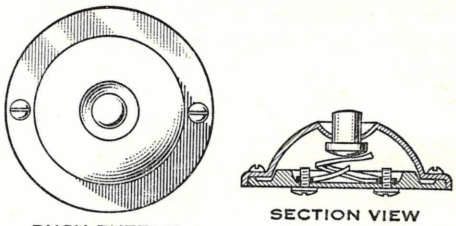


Fig. 275—The push button is used on door bell circuits

JOB NO. 58

HOW TO INSTALL A PUSH BUTTON

Since the push button is used only on low voltage circuits, the household mechanic should be able to install one. The job requires only a few simple tools.

Materials Necessary:

A push button, two screws for attaching, and annunciator wire.

Equipment Necessary:

A screw driver, pair of pliers, small drill, and a knife for scraping the wires.

Here Is a Good Plan to Follow.

1. Clean the ends of the wires to be attached. This may include removing the insulation. (See page 93.)
2. Bend attachment loops on the ends of the wires.

Fig. 276—There is a right way to attach a wire to a binding post

3. Attach the wires to the binding posts. There should be only two wires.
4. Mark the location of the screw holes for the push button with a pencil. The push button is usually installed over the hole where the wires come through.

5. Drill anchor holes with a small drill. (See page 8.)
6. Fasten push button in place with screws.
7. Test.

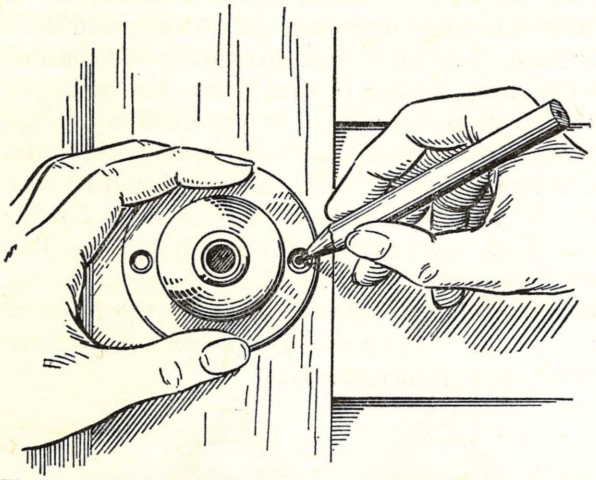


Fig. 277—The location of the screw holes should be marked

Test:

1. Can a push button be used for a 110-volt light circuit?
2. A loop should be made around a binding post in the same direction the screw is _____.
3. What kind of insulation is used on annunciator wire?
4. What would happen if only one wire were attached?
5. What would happen if the bare wires touched each other?

Spring Switches

Numerous types of lighting control switches may be classed as spring switches. The operating principle is much the same in all of them. A spring snaps the tumbler into place when the switch is turned on or off. The outside appearance of these switches varies considerably. Some may be operated by means of a chain, some with a lever, and some with a button. These switches are used for light circuits in houses, and may be installed in the form of wall switches, socket switches, and switches on electric appliances. (See Figs. 278 to 284.)

The toggle type wall switch is installed only in metal switch boxes, usually set into the wall. It usually controls all permanent fixtures in a room, because it is located near the door, where it can be found easily in the dark.

Two-Way and Three-Way Switches

It is often convenient to have two or three switches controlling the same light, as in case of the house and garage combination. This kind of a

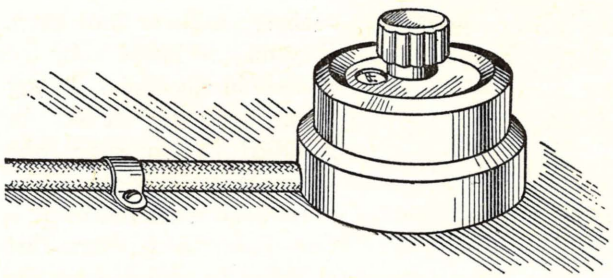


Fig. 278—The snap switch is used on the surface of a wall where the wiring is exposed

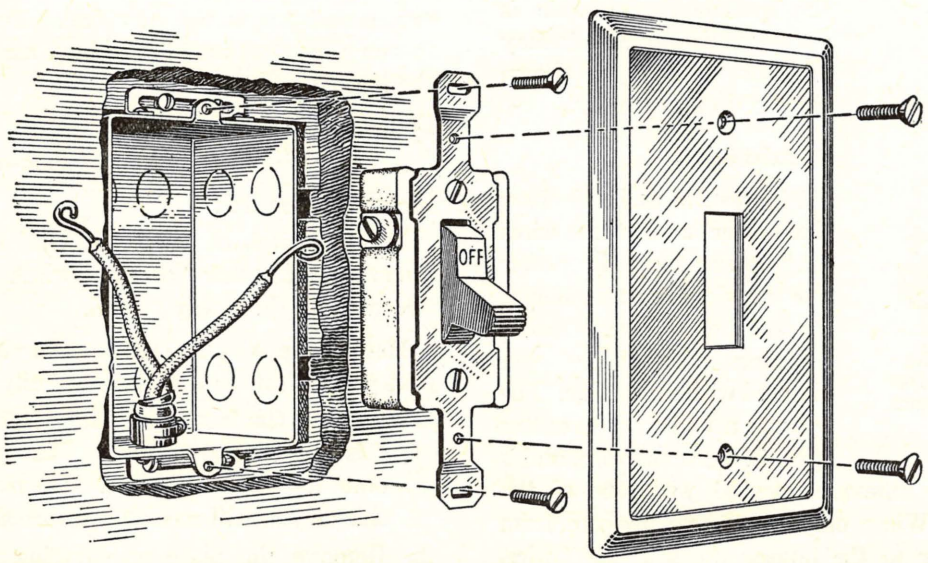


Fig. 279—Outlet box for toggle switch Fig. 280—Toggle switch Fig. 281—Cover of toggle switch

hookup requires special switches. The ordinary one-way switch has two binding posts of attaching wires. The two-way switch has three binding posts, and the three-way switch has four binding posts. It is important for the household mechanic to know know this in order that he may purchase the proper kind when replacing an old wall switch or snap switch. For more information, see Job No. 59.

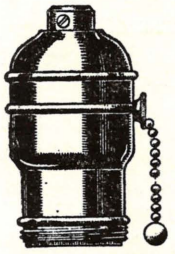


Fig. 282—The chain pull type socket switch used on a pendant or drop cord fixture

Chain pull, key, and push socket switches are often used on table lamps and other portable fixtures.

Installing and Replacing Spring Switches

Spring switches are usually regarded as part of the permanent wiring of a house, and therefore they should be installed by the licensed electrician. However, when they are a part of a movable fixture, such as a table or floor lamp, they may be installed by the household mechanic. In any case, switches should be installed by someone who knows what he is doing.

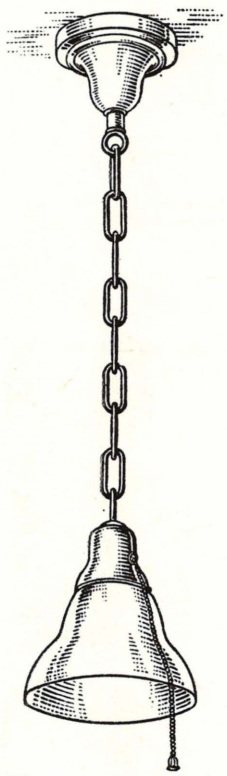


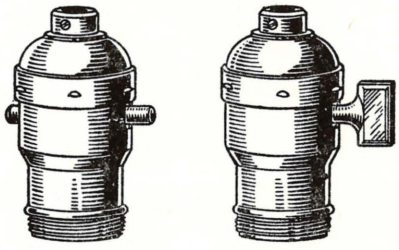
Fig. 283—A pendant fixture with a chain pull

In some communities it is the rule that worn-out switches be replaced by the licensed electrician. This rule is often violated. Since the household mechanic is apt to do it anyway, it may be best that he be shown how to do it correctly.

Polarization

Figures 248 and 249 show that either two or three wires may be run from the power line transformer to the house. Two of these wires are "hot", meaning that they are charged with electricity. The other, usually the center wire, is a ground wire, and is not dangerous unless connected with one of the "hot" wires. When only two wires are run from the transformer to the house, one is a "hot" wire, and the other is a ground wire.

Throughout the house, a ground wire and a hot wire are run to every fixture, switch or outlet. Electricians use a white insulated wire for the ground wire, and a black insulated wire for the hot wire. Notice that every fixture, switch or outlet has a brassy colored binding post, and a lead colored binding post. The hot wire should always be connected to the brassy colored binding post. The white, or ground wire, should always be connected to the lead colored binding post. In replacing a switch, outlet or fixture, the household mechanic should be very careful to transfer each wire to the same binding post on the new fixture that it was on the old. This extreme caution should be taken because the brassy colored binding post is insulated from the frame of the fixture, thus preventing a person touching the fixture from getting a shock.



PUSH TYPE KEY TYPE

Fig. 284—Push type and key type sockets

JOB NO. 59

HOW TO REPLACE A SPRING SWITCH

Please note that the title of this job is to replace, and not to install. A switch is replaced when the wiring is already installed, and all there is to do is to remove the worn-out mechanical part of the switch and put in the new one. To install means to run the wire, install the box, and connect with the house current.

Equipment Needed:

A screwdriver and a pair of long-nosed pliers.

Materials Needed:

A new switch of the same kind being replaced. Determine whether the old switch is a one-way, two-way, or three-way switch.

Here Is the Way To Do It. It is vitally important that you follow instructions carefully.

1. Remove the fuse controlling the circuit to which this switch is attached. This will have to be done at the switch box. Do not forget to do this or you will receive a severe shock.
2. Remove the plate or covering of the switch. (See Figs. 285-287.)

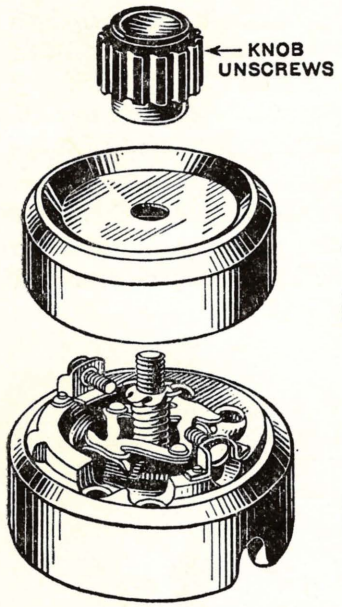


Fig. 285—Snap switch with cover removed

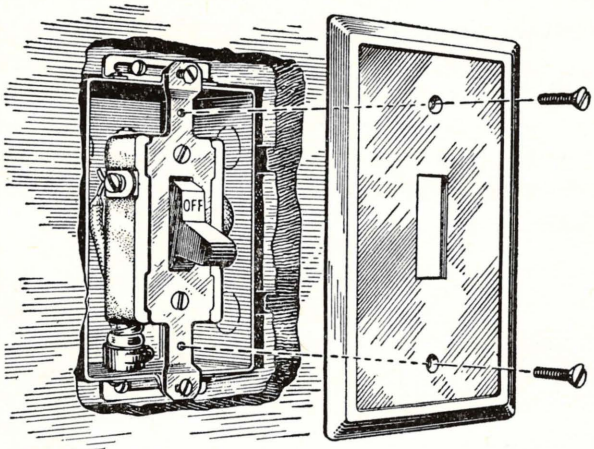


Fig. 286(*a*)—Toggle switch with cover removed
Fig. 286(*b*)—Cover of toggle switch

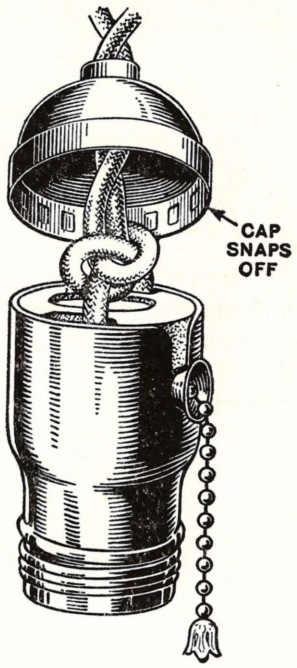


Fig. 287—Pull chain switch with cap removed

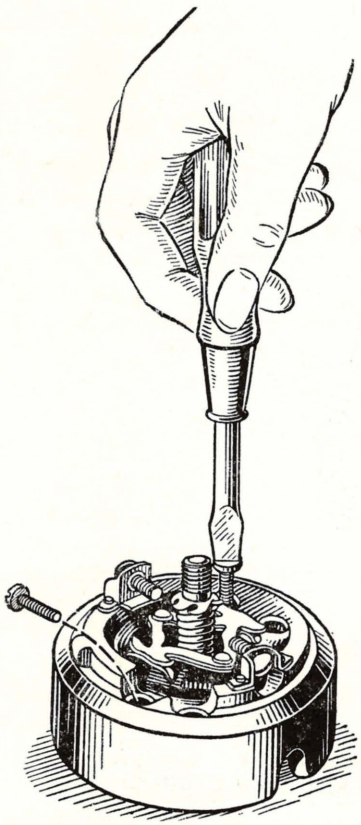


Fig. 288—Removing snap switch

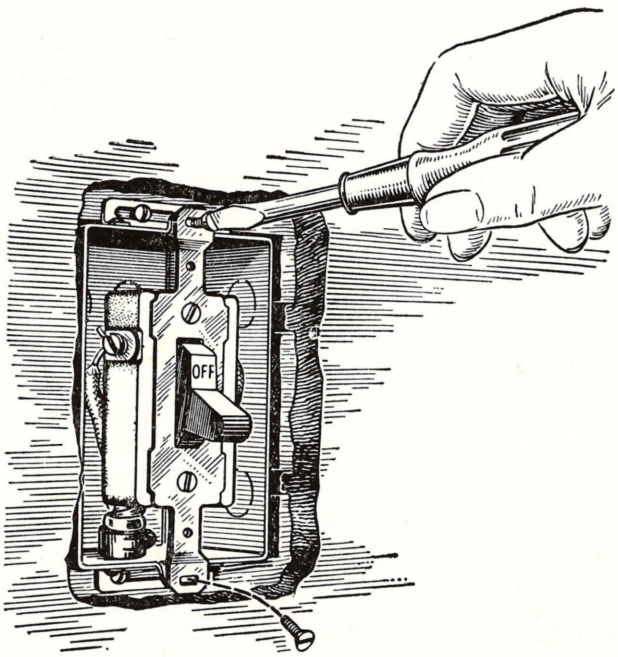


Fig. 289—Removing toggle switch

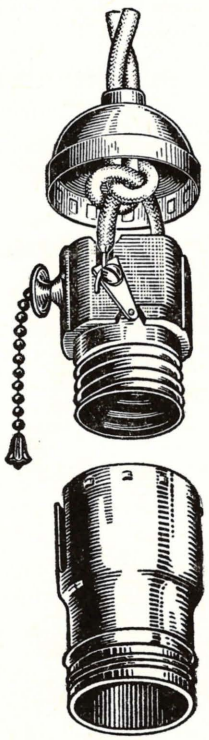


Fig. 290—Removing wires from chain pull switch

3. Remove the mechanical part of the switch. (See Figs. 288-290.)
4. Transfer the wires, one at a time from the old to the new switch. Be sure that each wire is fastened to the same binding post on the new switch as it was on the old. Screws must be tightened firmly.
5. Fasten the new mechanical part in place.
6. Replace the cover. In the case of the snap switch, the new cover should be used. In case of the wall switch, the old plate can be used if it is the same type of wall switch. In case of the socket switch, the old shell can usually be replaced over the new mechanical part.
7. Replace fuse and test.

Test:

1. Which type of switch is installed in a box?
2. Why is the inside of the shell of a socket lined with paper?
3. Where is the snap switch generally used?
4. Why isn't it necessary to solder the connections on a switch?
5. Is the household mechanic permitted to install or replace switches?

JOB NO. 60

HOW TO INSTALL AN ELECTRIC LIGHT SOCKET

The plain electric light socket is exactly the same as the socket switch except that it has no switch on it. The household mechanic often has need for installing a socket on a lamp or on the end of an extension cord.

Equipment Needed:

A pair of pliers, a knife, and a screwdriver.

Materials Needed:

A light socket and the cord to which it is to be attached.

Here Is a Plan for Doing the Job. Follow it carefully, because an error may mean a blown-out fuse.

1. Take the socket apart. A protective gasket is needed if the socket is to be used on an extension cord or drop light. If it is to be used in a table or floor lamp, the regular screw fitting is enough. The cap may be removed by pressing with the thumb at the place marked on the socket, and turning the cap off with the other hand.
2. Run the cord through the cap and anchor it by tying the underwriters knot, or, if appliance cord is used, by making the taped overhand knot. (See page 103.)

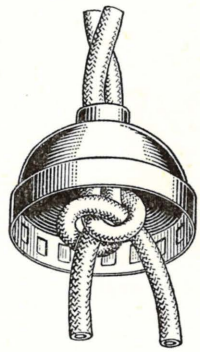


Fig. 294—The underwriters knot relieves strain on the binding posts

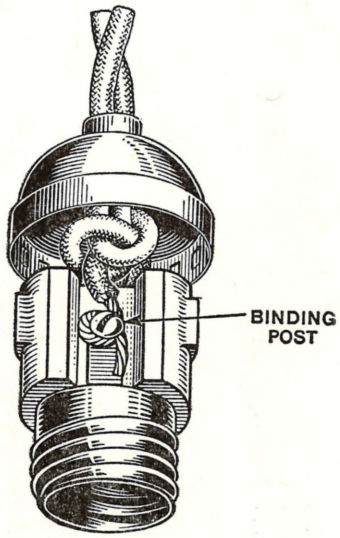
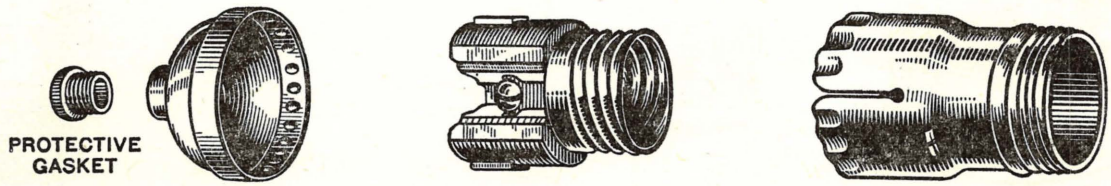


Fig. 295—The wire is wound around the binding post in the same direction that the screw turns down



Figs. 291–292–293—A light socket must be taken apart in order to attach a cord

3. Remove the insulation from the ends of the wires. Remove no more than is necessary. The insulation should be left clear up to the binding posts.
4. Twist the fine wires into a compact cable so that they will stay together.
5. Attach the wires to the binding posts. Remember to wind the wires around the binding post in the same direction the screw is turned down. (See Fig. 295.)
6. Assemble the socket.
7. Test by screwing an electric light in the socket and plugging the other end in a wall outlet.

Does Your Job Pass Inspection? These Questions May Give You the Answer.

1. Is the socket put together properly?
2. Did the electric light work when the cord was tested?
3. Did it blow a fuse when plugged into the wall outlet?
4. What is the difference between the socket switch and the socket?
5. What is the purpose of the underwriters knot?

Mercury Switches

The mercury switch has been invented during recent years. It has several advantages over spring switches. There are no mechanical parts to wear out. It is absolutely silent when turned on or off. It is ordinarily made for wall switches only, and can be installed in the regular wall switch box. The appearance of the mercury switch is no different from any other switch. The instructions for installing or replacing are the same as for the regular spring type wall switch.

Knife Switches

Another form of switch is the knife switch. It is used most for power lines of 110 volts or over.

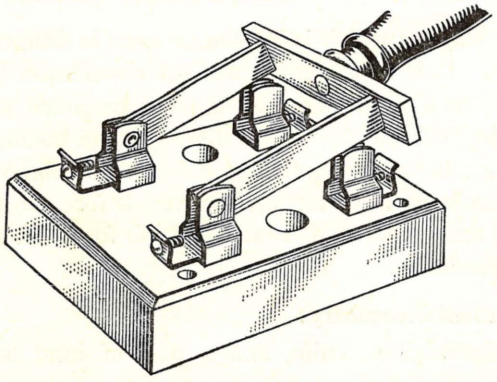


Fig. 296—The knife switch is used on main line circuits

The mere presence of one of these switches should mean "hands off," unless one is thoroughly familiar with the handling of current. They are not dangerous if used correctly, but it is wise for the beginner to leave them alone.

There is another switch which should be mentioned at this time. It is the service switch where the electric current enters the house. This switch is a knife switch and is usually enclosed in a metal box. It is operated by means of a handle on the outside of the box. In case of fire, or when closing the house for a long period of time, this switch should be opened. This switch should also be opened when making electric repairs or adjustments.

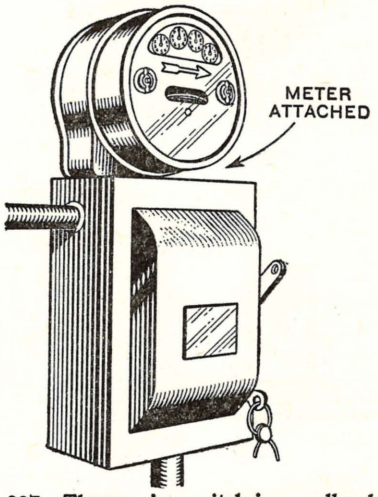


Fig. 297—The service switch is usually placed in a metal cabinet

The licensed electrician is the only person to install or to remove the service switch.

Wall Outlets

A wall outlet is a device used to provide a handy source of electricity for the many electric appliances used in the modern home. Outlets are usually installed in the wall just above the baseboard, but may also be found in other handy locations. The bathroom-light fixture, for example, often contains an outlet for an electric razor or hair dryer. Most wall outlets are "Hot." This means that no switch is needed to turn on the current, because the circuit is complete up to the outlet. This makes wall outlets dangerous for small children who are apt to stick hairpins or other metal objects into them. In the living room where floor lamps are used, the wall outlets are often controlled by the wall switch. This eliminates the dangerous job of fumbling in the dark to find the floor lamp. The switch at the lamp can be left turned on, and

the lights can be turned off at the wall switch by the door.

The screw plug is a type of outlet found in most homes. It serves as an emergency outlet. It can be screwed into a light socket and used as an outlet for electric fans, vacuum cleaners, and other appliances. It should never be used for electric flatirons or other heating devices because the switches and wiring in light fixtures are not heavy enough for heating appliances. (See page 113.)

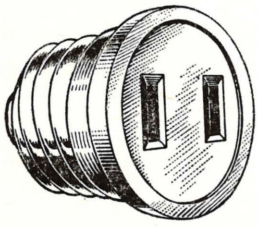


Fig. 298—Screw plug

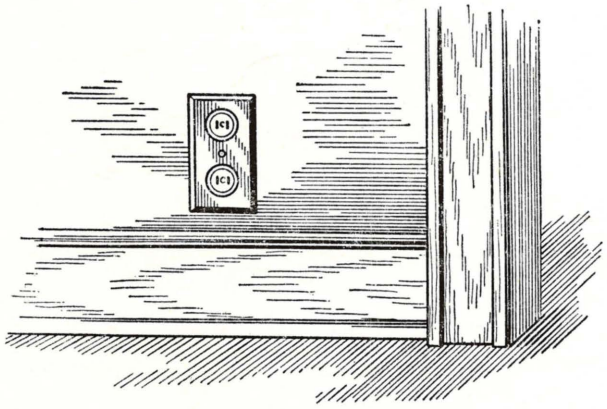


Fig. 299—Wall outlet

Installing and Replacing Wall Outlets

Wall outlets, like switches, should never be installed by the household mechanic, because they are a part of the permanent wiring of the house. Fortunately, there is very little about them to wear out, so they seldom need replacing. When they do, the same rules apply as for wall switches.

Electric Plugs

An electric plug is a device for connecting an electric appliance with the house current. It is very important in the maintenance of the home, and the household mechanic should be able to install, care for, and repair it. There are two kinds of electric plugs commonly used in the home; the wall plug for connecting into the house circuit, and the attachment plug for attaching the appliance cord to the appliance.

The Wall Plug

The wall plug is found on the end of appliance cords. There is very little to learn about it, for it is very simple in construction. Its principal parts are two prongs which fit into the wall outlet on one

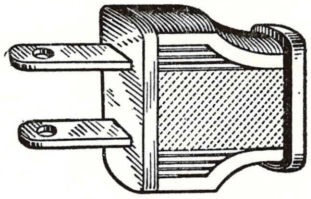


Fig. 300—Flat plug

end, and to which the wires of the extension cord are attached on the other end. These prongs are mounted in an insulating material such as rubber

Fig. 301—Round plug

or plastic. Recently, wall plugs have been made of a soft rubber compound which does not break when dropped or stepped on.

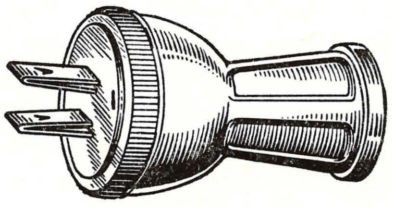


Fig. 302—Heavy duty plug

JOB NO. 61

HOW TO INSTALL A WALL PLUG

A wall plug which is broken or loose is dangerous to use. It is apt to cause a short circuit and blow a fuse, or give the user a very severe shock when plugging it into the wall outlet. If the insulation on the wire is worn, the plug should be removed, and the worn parts cut off the wire before the plug is put on again. This is an ideal job for the household mechanic.

Equipment Necessary:

A screwdriver, knife, and a pair of long nosed pliers.

Materials Necessary:

Friction tape, the wall plug, and the cord on which the plug is to be fastened.

Here Is a Plan to Follow. Work carefully and avoid burning out fuses.

1. Run the end of the cord through the plug.
2. Remove the outside insulation from about four inches of wire. Do not damage the rubber insulation on the individual wires.

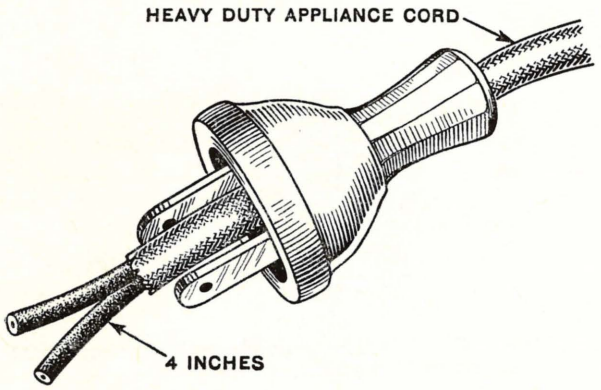


Fig. 303—The outside insulation is removed after the cord has been run through the plug

3. Bind the outside insulation to keep it from unraveling. This is not always done, but it is a good idea. Lamp cord can be bound with about two turns of friction tape. Appliance cord should have about a dozen turns of fine string or thread. (See Figs. 304-305.)
4. Tie the knot to keep the cord from pulling through the plug. Two kinds of knots are commonly used. The underwriters knot is usually found on lamp cords because the cord is not so large. For appliance cords, an ordi-

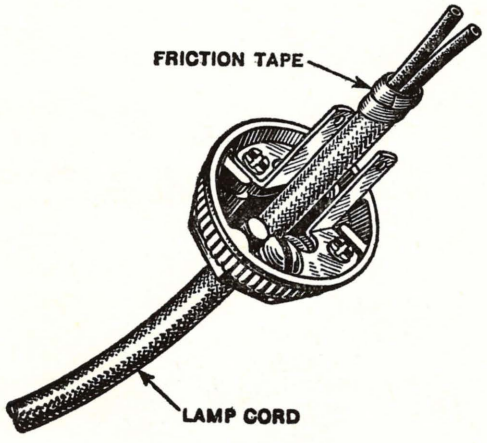


Fig. 304—Binding lamp cord

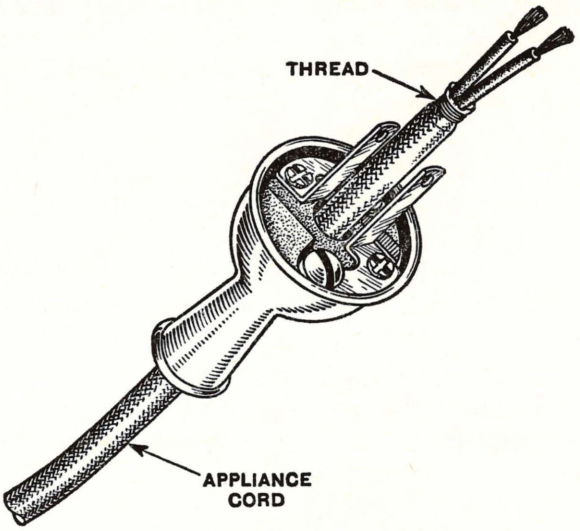


Fig. 305—Binding appliance cord

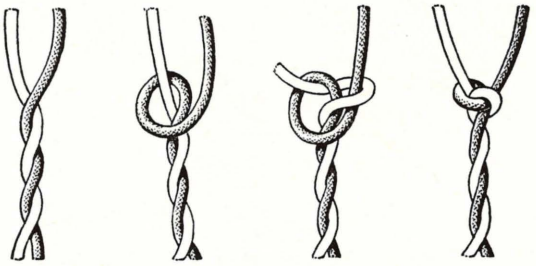


Fig. 306—Steps in tying the underwriters knot for lamp cords

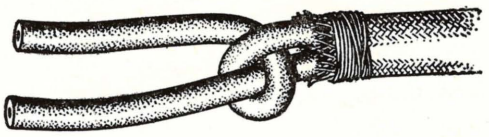


Fig. 307(*a*)—A knot is tied in the cord to relieve the strain on the binding posts

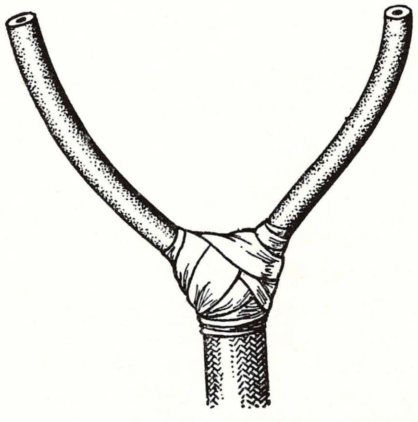
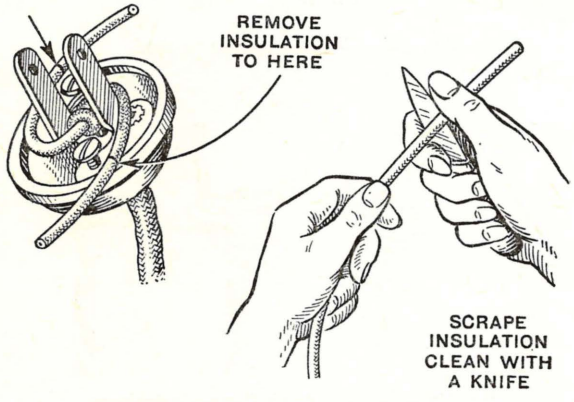


Fig. 307(*b*)—The taped overhand knot for appliance cords

nary overhand knot taped with friction tape is used. Either one may be used, since each serves the same purpose. The knot also relieves the strain on the binding posts.

5. Prepare the ends of the wires for attaching. Pull the cord back through the plug as far as it will go, forcing the knot next to the hole. Wrap the wires around the prongs of the plug and measure where the insulation is to be removed. The insulation must be left on the wires clear up to the binding posts.
6. Attach the wires to the binding posts. The strands of fine wire should be twisted into a solid cable before they are wound around the



308(*a*) 308(*b*)

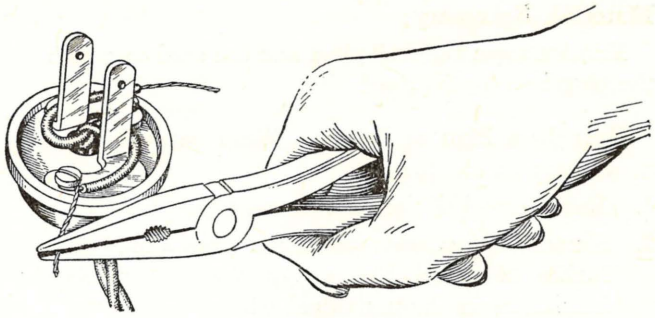
Figs. 308(*a*) and 308(*b*)—Remove insulation from the binding posts to the ends of the wires

binding post. (See Fig. 309.) The screws should be turned down tight with the screwdriver.

7. Trim off all fine wires which may not have been twisted with the rest. These will cause short circuits if they touch the other prong after it is plugged into the wall outlet.

You Should Now Have a Perfect Job. Plug It Into the Wall Outlet and Test It.

1. Did it blow a fuse?
2. Why was the underwriters knot used?
3. Why are the long-nosed pliers better for this purpose than regular pliers?
4. Why should the insulation be bound with thread or tape?
5. Why should the fine wires be twisted into a compact cable.



309 (*a*)

309 (*b*)

Figs. 309(*a*) and 309(*b*)—The wires in a wall plug should pass around the outside of each prong

The Appliance Plug or Attachment Piece

The appliance plug is used on most heating appliances. It is used for several reasons. The appliance is usually too hot when it is put away to wrap the cord around it without burning the cord. When the appliance plug is used, the cord may be removed and stored separately. Appliances are

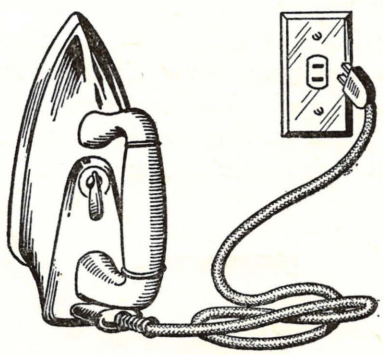


Fig. 310—Always disconnect an appliance at the wall outlet, never at the appliance plug

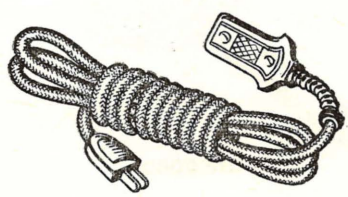


Fig. 311—Appliance cord with an appliance plug and a wall plug

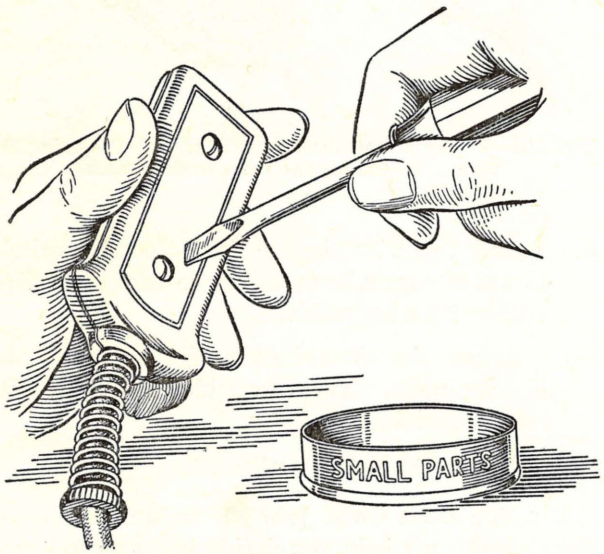
often used without the cord, as in the case of the coffee pot or tea kettle. Also, the appliance plug furnishes a connection which does not wear out or burn as quickly as an ordinary connection.

Spring clips on the inside of the appliance plug fit over two metal prongs on the appliance. An appliance should always be connected or disconnected at the wall plug because electric sparks burn the metal prongs on the appliance when the clips are slipped over them. Prongs which are badly burned do not make a good connection.

JOB NO. 62

INSTALLING AN APPLIANCE PLUG

The insulation of an appliance cord often becomes worn at the plug. It is dangerous to use in this condition, and should be repaired. The household mechanic can make this repair if he is willing to follow carefully this plan of work.



312 (*a*) 312 (*b*)

Figs. 312(*a*) and 312(*b*)—The appliance plug may be taken apart with a screwdriver

Necessary Materials:

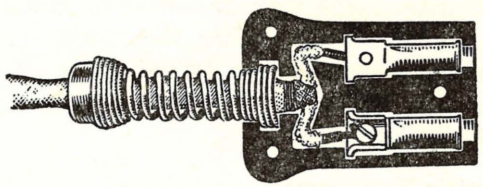
Some thread or fine string for binding the insulation, and appliance plug and the appliance cord.

Necessary Equipment:

A screwdriver, a knife, and a pair of pliers.

Here Is a Plan for Doing the Job. Work carefully and avoid blowing a fuse.

1. Take the appliance plug apart by removing the bolts which hold it together. Be careful not to lose the nuts. It is a good plan to have a can or box to hold small parts. Some plugs are held together with spring clips or rivets instead of screws.
2. Cut off the damaged portion of the cord and clean new ends. The old ends may be used to get an idea of the amount of insulation to be removed. Also note that the asbestos insulation is left on the wires clear up to the binding post. (See Fig. 313.)



Figs. 314—The parts in place for assembling

3. Bind the outside insulation with thread to keep it from unraveling.
4. Attach the wires to the spring clips. Remember that the wires should be wound around the binding posts in the same direction the screw is turned down.
5. Place the wires inside of the shell of the plug. Notice that one screw is turned up and the other down. Be sure to get the spring bushing in place.
6. Lay the cover in place. If all parts are not in their proper place the cover will not go on.
7. Fasten with the bolts and screwdriver.
8. Test on an electric appliance to see if it works.

Did You Do a Good Job? These questions may help you decide.

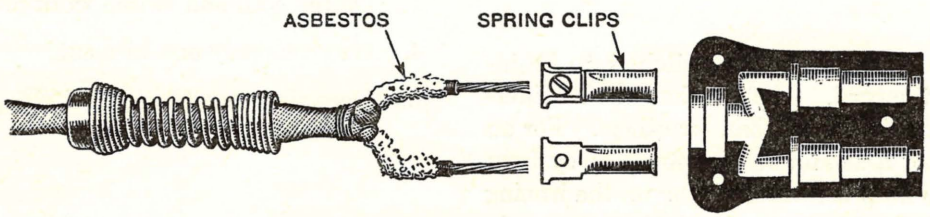


Fig. 313—The parts of an appliance plug

1. Does the plug work smoothly on the prongs of the appliance?
2. Does the plug fit together properly?
3. Did you blow a fuse when you plugged the appliance into a wall outlet?
4. Should a flat iron be disconnected at the appliance or the wall outlet?
5. What purpose does the spring bushing serve on an appliance plug?

JOB NO. 63

INSTALLING A FEED THROUGH SWITCH

It is very unhandy to go to the wall outlet every time the electric toaster has to be turned on or off. These extra steps may be saved by installing a feed through switch. Then the toaster or other electric appliance may be turned on or off within easy reach. This switch can be installed quickly and easily.

Materials Necessary:

A pair of pliers, a knife, a feed through switch, the appliance cord, and some thread to keep the outside insulation from unraveling.

Here Is a Plan for Installing a Feed Through Switch. If you follow instructions carefully, you should be able to do a good job.

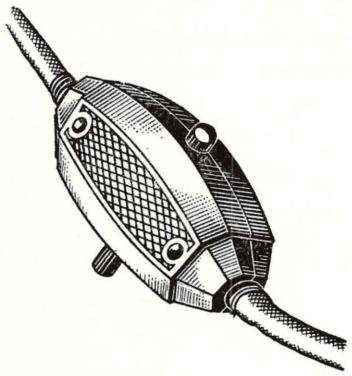


Fig. 315—The feed through switch

1. Select the place where the switch is to be installed in the cord. The location will be different for some appliances than for others. For an electric iron, it should be far enough away from the iron to keep it from dragging on the ironing board. It should always be within easy reach.
2. Wind two pieces of thread around the wire $2\frac{1}{2}''$ apart, at the place where the switch is to be installed. This is to keep the insulation from unraveling. Friction tape may be used.
3. Remove the outside insulation between the threads. Only the outside insulation should be removed. Be very careful not to break the rubber insulation. (See Fig. 316.)
4. Cut one of the wires half way between the threads. Remove the rubber insulation about $\frac{1}{2}''$ from each of these ends. Scrape the wires clean, and twist each into a firm cable.

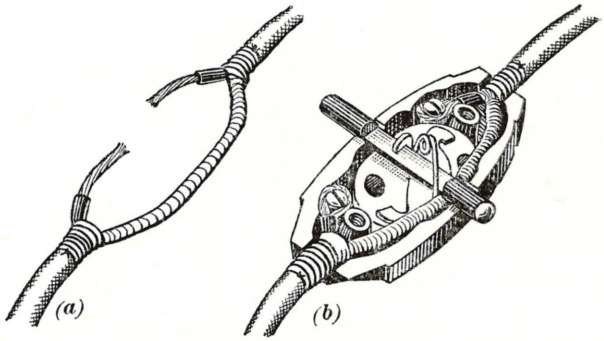


Fig. 316—Wiring a feed through switch. (*a*) Preparing the wire. (*b*) Placing the wires in the switch

5. Install the wires in the feed through switch. It will of course be necessary to take the switch apart with a screwdriver.

   Attach the cleaned ends of the wire to the binding posts. The wire which is not cut fits into a special groove.
6. Assemble the switch and test it.

Did You Do a Good Job? Here are some questions which may help you decide just how well you did it.

1. Has the insulation been neatly wrapped to prevent unraveling?
2. Is the switch placed on the cord where it will be handy?
3. Do the cord and switch work properly?
4. Why was only one wire cut?
5. Does the feed through switch open or close the circuit?

THE HOUSE CIRCUIT

The electric circuit has been discussed earlier in this chapter. In Fig. 239 it was shown how electric current passes from the source, through the appliance, and back to the source, making a complete circuit. Electric circuits in a house are the same except that the generators at the local power company are the source instead of the dry cell. In our discussion of the house circuit, we will refer to the service switch as the source of electricity, since the power company ends its responsibility at that point.

When a house is wired for electricity, the power company runs its wires to the house, through a meter, and then to a service switch. This is the switch to be used when the current is to be shut off all through the house. From this point on, the home owner must have the wiring done by a licensed electrician.

The electrician installs the wiring from the service switch to the fuse block, or box. Here the current is divided into a number of circuits. If the house is very small, there may be only one or two circuits. The average house may have eight or ten. The reason for this is to prevent the overloading of the house wiring.

Overload

It has already been explained that even copper wire offers some resistance to an electric current passing through it. The more current passing through a wire, the greater the resistance. Three electric appliances used at the same time on a circuit would cause more of a load than two, and, of course, more resistance. When too many electric appliances are used on a circuit, at the same time, the circuit is said to be overloaded. There is more of a load than the wires will carry safely. Resistance causes the wires to become hot, and hot wires are apt to cause fires. The number of appliances which can be used on a circuit depends upon the size of wire used when the house was wired, and the rate at which the appliances use electric current. The average home is wired with No. 14 copper wire. It will carry a load of 15 amps safely. (See Amperage.)

If all of the electric appliances in the average modern home were used at the same time, the total amperage would be far above 15. For this reason, house wiring is divided into a number of circuits. One circuit may go to the kitchen alone because of the large number of kitchen appliances in use today. Another circuit may go to two or three other rooms where the number of appliances is not apt to be so great. The electrician knows by experience just about how the circuits should be divided in order to balance the load.

Amperage

Reference has just been made to amps, or amperage. Amperage is the unit used to measure the rate at which electric current is being used. Motor driven appliances have the voltage and amperage mark stamped on the specifications plate.

Wattage

The rate at which electric lights and heating appliances use electric current is expressed usually in terms of watts, or wattage. It is the amperage multiplied by the voltage. If the voltage is 110 and the amperage is 5, the wattage is 5 times 110, or 550. If the wattage is given, divide by 110 to find the amperage. A 100-watt electric light bulb

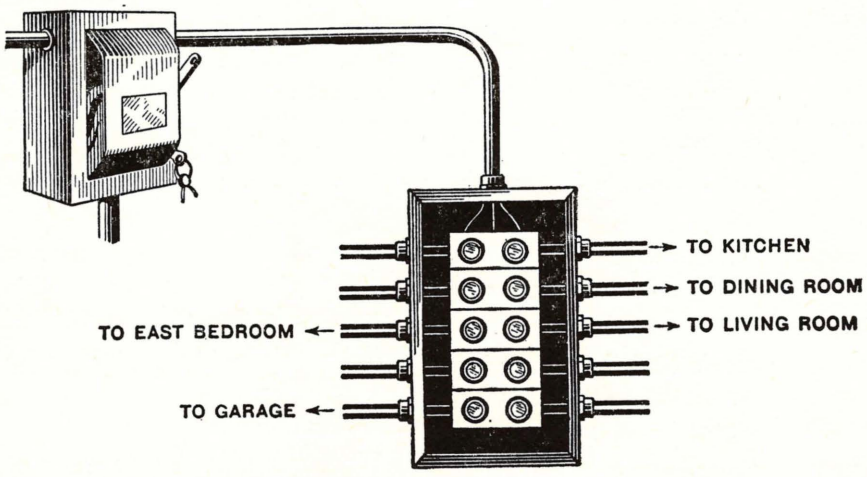


Fig. 317—House current is distributed through a number of circuits at the fuse block to the various rooms

uses less than 1 amp. A 660-watt electric toaster uses 6 amps.

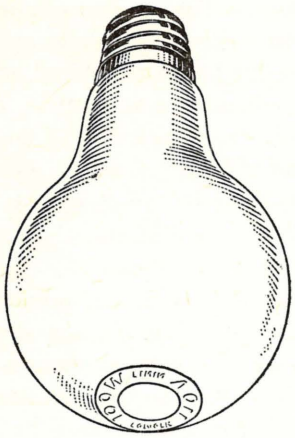


Fig. 318—A 100-watt electric light bulb uses electric current at the rate of a little less than 1 amp per hour

JOB NO. 64

HOW TO FIND THE LOAD ON AN ELECTRIC CIRCUIT

The household mechanic should know just how many appliances he can use on an electric circuit without overloading it. By using the above information, he can figure out whether or not he can safely use several appliances on the same circuit.

Here Is the Way to Proceed.

1. Figure the electric lights used on the circuit. For example, there may be three, 60 watt light bulbs. Altogether, they would use ..... 180 watts
2. Add to this, the wattage of any motor driven appliances used on the circuit. For example, the specifications plate on the washing machine may give the amperage at 5 amps. The wattage would be 110 times 5, or..... 550 watts
3. Add the wattage of heating appliances used on the circuit. For example, an electric flat iron may be rated at..... 700 watts
4. The total wattage would be..... 1430 watts
5. The amperage would be the wattage divided by the voltage, (110), or... 13 amps

Of what value is this problem?

It tells the household mechanic that the circuit is loaded within two amps of its limit, and that it is perfectly safe to use all equipment mentioned above. It might be well to figure the load on your circuits at home if fuses have been blown recently.

FUSES

A fuse is simply a piece of soft metal placed in an electric circuit which melts when the wires become too hot. When it melts, the circuit is broken, and all lights and appliances on that circuit refuse to work until the cause has been removed and the fuse replaced. This is commonly known as a "blown" fuse. Fuses blow because the circuit is overloaded, or because of short circuits.

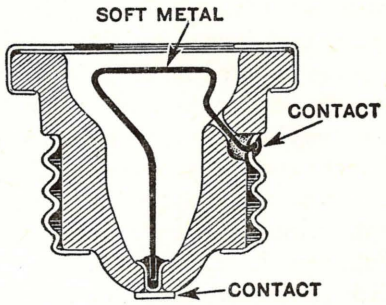


Fig. 319—Section of the common fuse plug used in a house lighting circuit

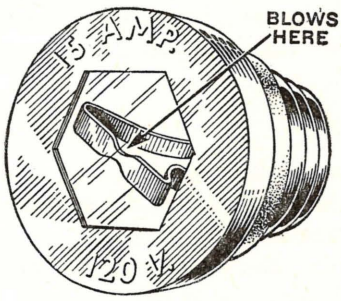


Fig. 320—Exposed front of fuse

When the electrician has divided the house current into circuits at the fuse box, he puts a fuse into each of the circuits. If the house is wired with No. 14 copper wire, and most of them are, he uses 15 amp fuses. This size fuse is used because No. 14 wire will carry a load of 15 amps safely. Lights and appliances using a total of 15 amps may be used at one time without overloading the circuit, or blowing a fuse. An overload of one or two amps may not blow a fuse instantly, since it takes some time to get the wires hot enough. A heavier fuse should never be used without the approval of a licensed electrician. A fuse which is too heavy may be the reason for a very bad fire. If fuses blow quite often, the cause should be determined. Never run a wire, (jumper), around a fuse. This leaves the circuit completely unprotected.

The Short Circuit

Whenever two electric wires of the same circuit touch each other, or become connected in any way

by a conductor of electricity between the source and the appliance, a short circuit is formed. The insulation may be poor and the current may jump, or arc from one wire to the other. The insulation may be worn off allowing the wires to touch, making a direct connection. Some other wire, or metal object, may touch both wires, making a direct connection. Anything which shortens the path of the electric current, and allows it to form a complete circuit without passing through its regular path may cause a short circuit.

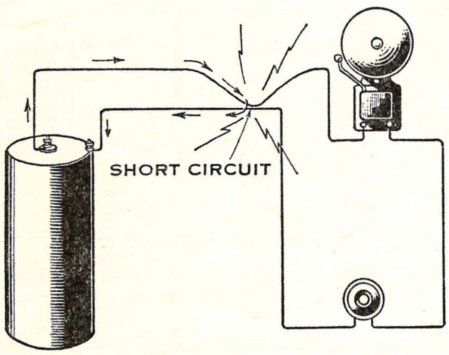


Fig. 321—A short circuit causes overheated wires

When a short circuit is present, the electric current takes a short cut, and does not pass through the appliance as it should. The electric current which is ordinarily used by the appliance generates heat in the wires between the short and the source. In an instant, the wires may become hot enough to burn off the insulation and start a fire. The electric appliance supplied by the wires does not operate, because the electric current does not go that far.

Short circuits in appliance cords are common causes of blown fuses. Defective wall plugs, appliance plugs, and sockets should always be replaced with new ones as soon as the old ones are found to be defective.

JOB NO. 65

HOW TO REPLACE A BLOWN FUSE

In some localities, the electric power companies will come to the home and replace blown fuses on a few minutes notice, free of any charge. In other localities, the home owner must call an electrician or do it himself. In any case, it is well for the household mechanic to be able to do the job.

Materials Needed:

It is a good plan to have several fuses of the same amperage as the ones in the fuse box, in a place where they can be found easily when a fuse blows.

Here Is Some Good Advice to Follow.

1. Pull out all appliance plugs in the circuit in which the fuse is blown.
2. Locate the blown fuse in the fuse box. This may have to be done with the aid of a flashlight. If a chart has been made showing the location of the fuse for each circuit, this will be easy. Otherwise, look for a burned spot on the mica covering of the fuse. A break in the fuse metal may be seen if you look closely.

Safety Measures: Do not stand on a wet floor or touch a metal pipe while replacing fuses.

Never use a fuse plug in which the mica or fuse wire has been broken or damaged.

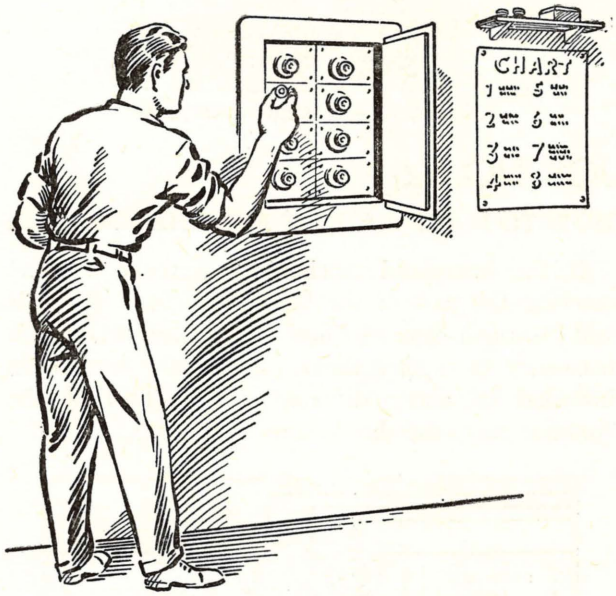


Fig. 322—Be sure to stand on a dry floor while replacing fuses

3. Replace the fuse. The lights should come on as soon as the new fuse is screwed into place. If the new fuse blows, there must be a short in the lights. Be sure all table and floor lamp cords are pulled from the wall outlets before putting in another fuse.
4. Inspect all cords, plugs, and sockets to determine the cause of the blown fuse.
5. Replace all defective cords, plugs, or sockets, if any are found.
6. If nothing is found wrong with the cords, plug each appliance into the wall outlet separately. If any appliance is defective, it will blow a fuse. The appliance should be repaired.
7. If all appliances operate separately without

blowing another fuse, the circuit must have been overloaded. To use more appliances, an electrician should be consulted. He will install another circuit, or rewire the present one with heavier wire so that it will carry a heavier load.

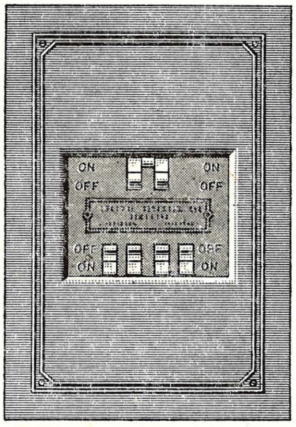


Fig. 322(a)—A typical switch panel

JOB NO. 66

HOW TO MAKE A CHART FOR THE FUSE BOX

If the household mechanic will make a chart showing the part of the house each fuse serves, it will be much easier to find blown fuses when it is necessary to replace them. Fuses may have been installed in many different ways. Two of the common ways are shown here.

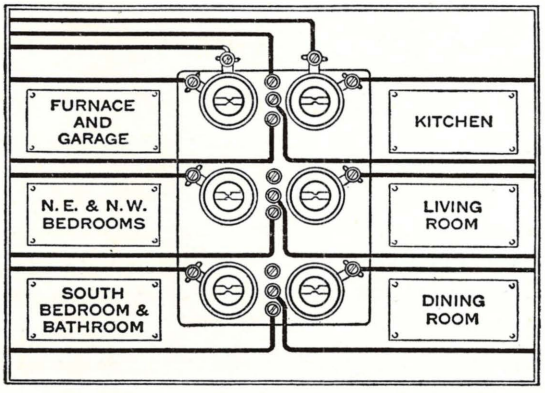


Fig. 323—When fuses are mounted on a panel, tags with the necessary information to mark each circuit may be tacked to the panel near each fuse

Here Is a Way to Find the Circuits.

1. Remove a fuse. Then go up stairs and test lights and outlets until the ones are found that do not work.
2. List this information on the chart or card.
3. Replace the fuse and try the next one.

Here Is a Test of Your Knowledge of House Circuits and Fuses.

1. Why is the house current divided into a number of circuits?
2. How many amps will the ordinary house circuit carry safely?
3. What is an amp?

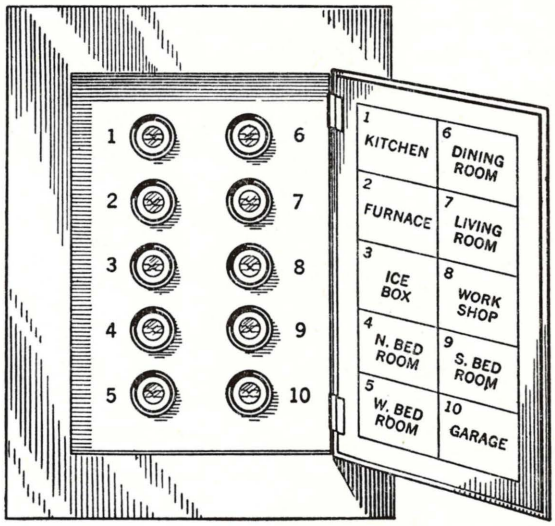


Fig. 324—The modern fuse box has each fuse numbered, and has a chart on the inside of the door

4. What size wire is ordinarily used for house wiring?
5. What size wire is often used to permit the use of more electric appliances?
6. What is a fuse?
7. How many amps will the ordinary house fuse carry without blowing out?
8. What is the danger of using too heavy a fuse?
9. How will you know what size fuse to use?
10. What is a short circuit?
11. What effect does a short circuit have on fuses?
12. What would probably happen in case of a short circuit if no fuses were used?
13. What is an overload?
14. Will an overload blow a fuse?
15. If a fuse blows the instant an appliance is plugged in, what is probably the cause?
16. In case a plug is found to have a short in it, what would you do about it?
17. State one safety precaution for replacing fuses.
18. How can you tell when a fuse is blown?

19. How many amps would be used for eleven 100-watt light bulbs on a 110-volt circuit?
20. How would you transform amperage into wattage?

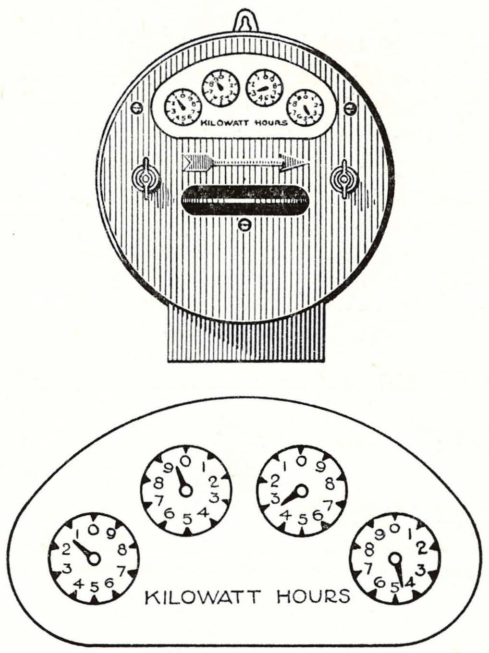
USING, MEASURING, AND PAYING FOR ELECTRICITY—METER READING

People often complain that their light bill is too high. This is often due to carelessness in leaving lights turned on when they are not needed. Some electric appliances use more current than others. Heating appliances such as toasters, flat irons, and heaters, use more current than the small motor used in appliances. Electric fans, vacuum cleaners, and washing machines use only a small amount of electricity. Before complaining to the power company, it is well to check on the number of lights and appliances, and the length of time they are used.

In a previous experiment it was learned that a watt is a unit used to measure the amount of current used. A watt hour is the amount of current used in an hour. A 40-watt light bulb uses 40 watts of electricity in an hour. Power companies furnish electricity at the rate of so much per kilowatt hour, a measure which is equal to 1,000 watt hours. Once the wattage of an electric appliance is known, it is a simple matter to figure the cost of operating it. Some electric appliances have an amperage mark on them instead of a wattage mark. In this case the voltage should be multiplied by the amperage. In the case of a heater marked 4 amps, 110-V, the wattage would be 440. In an hour, the heater would consume 440 watt hours, or .44 kilowatt hours of electricity. Suppose ten 60-watt light bulbs are used for 24 hours. The number of kilowatts used would be, 10 times 60, times 24, divided by 1,000, or 14.4.

Occasionally it is desirable to check on the power company, for it bases the charges on the readings taken from the meter which is wired into the house circuit. In order to make this check it is necessary to know how to read an electric meter.

The face of the meter has four dials. The one to the right records 10 kilowatt-hours when the pointer makes one revolution in a clockwise direction. The next one to the left, records 100 kilowatt-hours when the pointer makes one revolution in a counter-clockwise direction. The third one to the left, moves clockwise, registering 1,000 kilowatt-hours and the fourth one moves counter-clockwise, registering 10,000 kilowatt-hours. The pointer on the first dial must make one complete revolution before the pointer on the second stands at one. When reading a meter, there is a general rule to follow. When the pointer is between two numbers, always read the smaller of the two numbers. For example, the reading on the meter in Fig. 325, should be 1934.



THE DIAL

Fig. 325—An electric meter used in houses

When the power company makes its reading, it subtracts from it the reading taken the month before. The difference is the number of kilowatt hours used during the past month. If the company's meter reader happens to make a mistake and get the reading too high or too low this month, the error will be corrected when the next reading is made and substracted from or added to last month's reading.

The electric bill shown in Fig. 326 is based on the "sliding scale" of charges now used by many companies. The rate is—

9 cents—gross per kilowatt-hour for first 10 kilowatt-hours per month
4 cents—gross per kilowatt-hour for next 40 kilowatt-hours per month.
2½ cents—gross per kilowatt-hour for excess over 50 kilowatt-hours per month.

In addition there is a 10% discount for prompt payment. The bill shows the September meter reading to have been 4738 kilowatt hours, at the end of one month the meter showed 4882 kilowatt hours; by subtracting the September reading from the October reading, the result is 144 kilowatt hours of current consumed. Computing the cost,

10 kwhr.@9 c =	.90
40 kwhr.@4c =	1.60
94 kwhr.@2½c =	2.35
144 kwhr. total =	4.85
3% Michigan Sales Tax	.14
Total Bill	4.99
10% Discount	.50
Amount	4.49

It would be real interesting to check your own electric bills, and it is a good problem in arithmetic. It is also interesting to check the amount of current consumed by some electric heater or a motor by taking a reading before and after using.

THE ELECTRIC COMPANY

John Doe

NOTICE: 100/103 OF THE AMOUNT CHARGED ON THIS BILL REPRESENTS COST OF ELECTRICAL ENERGY AND 3/103 OF SUCH AMOUNT IS THE MICHIGAN GENERAL SALES TAX.

NET BILL PAYABLE ON OR BEFORE → Oct. 19 RESIDENCE

METER READING DATES	METER READINGS PRESENT		KILOWATT HOURS 1ST STEP	GROSS BILL INCLUDING TAX
Oct 9	4882	FOR EXPLANATION OF RATE SEE REVERSE SIDE	10	4.85
	PRECEDING		TOTAL KILOWATT HOURS	NET BILL
Sept 8	4738		144	4 36 INCLUDING TAX

Fig. 326—Sample electric bill

JOB NO. 67

A TEST ON MEASURING AND PAYING FOR ELECTRICITY

Make a pasteboard dial of an electric meter, using pieces of tin for the pointers. Be sure the numbering on the dials is correct.

1. How many revolutions must the dial on the right make while the next one to it is moving one point?
2. How many kilowatt-hours of electricity would twelve 40-watt bulbs use in 20 hours?
3. How many kilowatt-hours of electricity would an electric flat iron, 110-V, 4.5 amp, use in 10 hours?
4. If the meter reading last month was 2,467, and this month 2,508, how many kilowatt hours were used during the month?
5. If the power company charges 10 cents per kilowatt-hour, what will be the amount of the light bill?

Electric Heating Appliances

In a previous experiment it was shown that when electricity passes through a wire, it produces heat. Electric heating devices depend upon the generation of heat, by passing an electric current through a special conductor known as resistance wire. The amount of heat produced depends upon the kind of wire used and the amount of current passing through it. The fineness and the length of resistance wire used in the heating element, partly determine the amount of heat it produces. A fine wire offers more resistance than a coarse wire of the same length. The resistance wire used in a heating element is finer than the copper wire used in the appliance cord. The coarse, low resistance wire

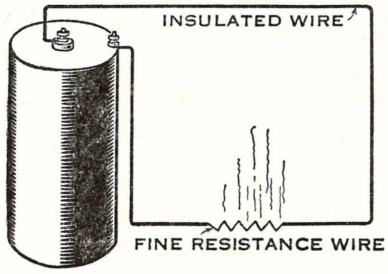


Fig. 327—Electric current passing through fine wires produces heat

used in the appliance cord heats very little, while the finer, high resistance wire, used in the heating element, becomes very hot. In some appliances, especially flatirons and toasters, a very thin resistance metal ribbon is used instead of wire.

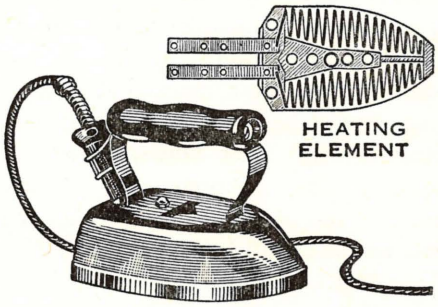


Fig. 328—The heating element in a flatiron is made of a special resistance wire

The heating element in all common heating appliances is made on the same principle. Because of differences in construction, the elements must be installed differently. In a flatiron, the bottom part must be heated with as little heat as possible going up through the top part of the iron. In an electric toaster, the element is usually installed so that heat is given off on all sides. Some electric hot plates have a grooved porcelain top into which the heating element fits. In all appliances, however, the heating element must be insulated from the

frame. It also must be installed so that the wires do not touch and become short circuited.

The Care of Heating Appliances

There are several rules which should be observed in the care of heating appliances.

1. Do not dip them in water. If the percolator needs washing, water may be poured inside, and the inside washed the same as any other utensil. If the heating element gets wet, it should be thoroughly dried out before using.

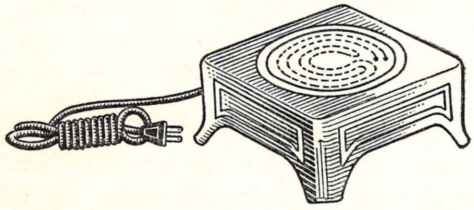


Fig. 329—The grooved porcelain top on an electric hot plate acts as an insulator for the heating element

2. Always connect or disconnect a heating appliance at the wall outlet first. (See page 105.)
3. A heating appliance should never be plugged into a light socket because the load is too heavy for lamp cord or for the ordinary socket switch. The lamp cord is apt to become too hot.
4. If an extension cord is used, be sure that it is heavy duty cord, and not ordinary lamp cord.

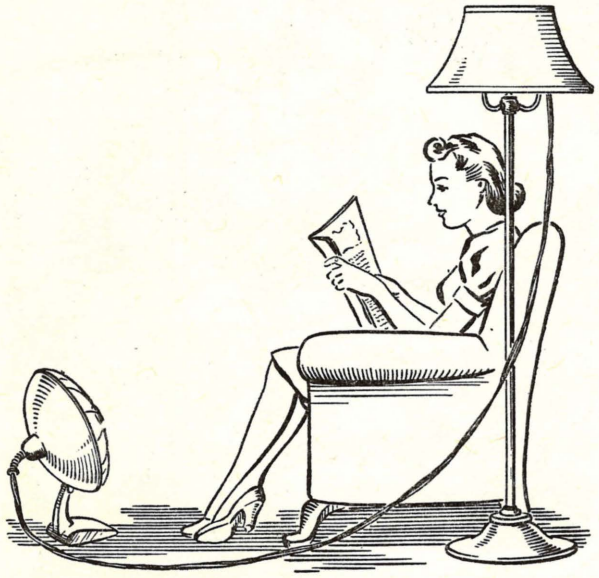


Fig. 330—Never plug a heating appliance into a light socket

The Repair of Heating Appliances

About the only thing which can go wrong with an electric heating appliance is for the heating element to burn out. In some appliances this is very easy to replace, while in others it is very difficult. The household mechanic will have to judge this for himself by careful inspection. For some appliances, a new heating element costs almost as much as a new appliance. In case the appliance is a good one, an electrician should be called.

Note: A heating element which has been spliced or shortened heats much faster and becomes much hotter than it did when it was new. It is also apt to burn out again in a very short time.

THE ELECTRIC LIGHT

The electric light is such a common convenience that the average person simply takes it for granted, without knowing why or how it makes a light. Upon close examination, an electric light bulb will be found to consist of a glass bulb with a filament of wire supported by a glass post, and sealed to a connection similar to a screw plug. The filament on the inside of the bulb is the part which actually produces the light.

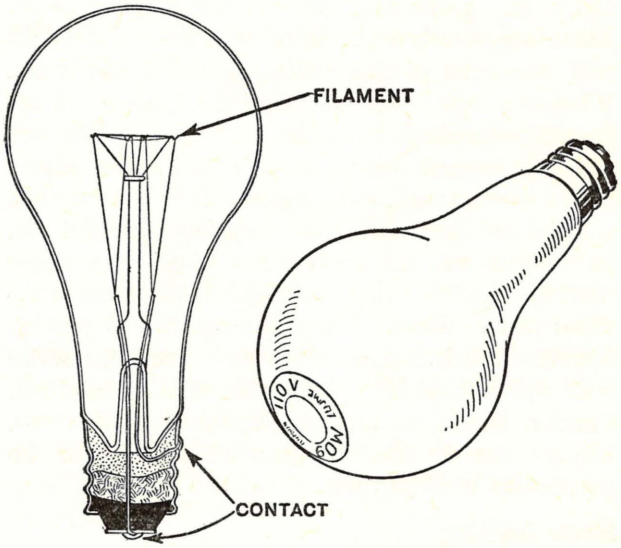
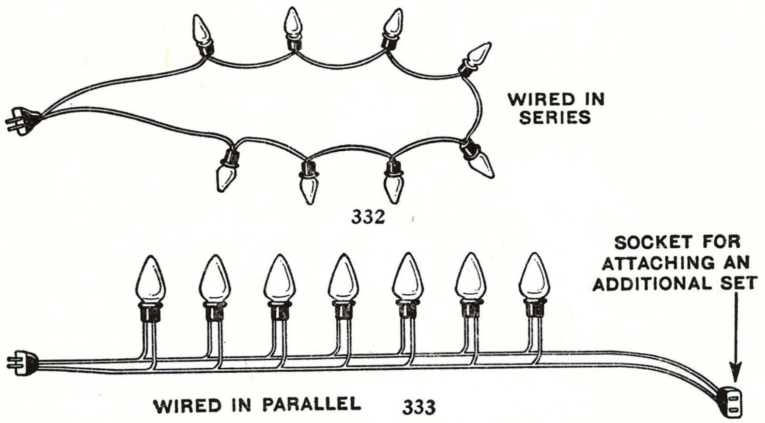


Fig. 331—An electric light bulb

In a past experiment it was shown that an electric current passing through a wire produces heat. The amount of heat depends partly upon the size of the wire. The wire used in electric light bulbs is made of a material called tungsten, which has a very high resistance. It has such a high resistance, and is drawn so fine, that when an electric current passes through it, the wire becomes white hot, thus giving off light.



Figs. 332-333—Christmas tree lights are wired in either series or parallel circuits

Electric light bulbs always have a voltage and a wattage mark on them. To avoid burning out the bulbs, it is always a good plan to be sure that the voltage mark is the same as, or higher than, the voltage in the circuit in which the bulbs are to be used. Bulbs marked 120-V should be used in a 110-volt circuit. Light bulbs used in an automobile light are ordinarily only 6-V. Less expensive sets of Christman tree lights have bulbs using less than 110 volts. These sets, however, are wired in series. There are usually eight lights to a set. Each light uses one-eight of 110 volts, or about $13\frac{3}{4}$ volts. When one light burns out, all of the lights in the set go out because the circuit is broken. The one which is burned out must be found and replaced before the set will work again. It is easy to tell a series set from the more expensive parallel set. In a series set, the sockets are wired on a single continuous wire. In a parallel set, the sockets are wired to two wires. There is no danger of putting a series bulb into a parallel set, because the series bulb will not fit into the socket of a parallel set. Caution should be used in buying them, however. Always look for the voltage mark. Bulbs for the parallel set use 110 volts.

Home Lighting

The amount of light given off by an electric light depends upon the wattage. Two 50-watt bulbs should give off the same amount of light as one 100-watt bulb. But there are other things which determine how effectively the light is used. The color and height of ceilings is important. Light-colored walls and ceilings reflect a great amount of light. The type of fixtures used is also very important. Some fixtures light up the entire room while others light up only a small area. The fixture should provide light where light is needed. Light and power companies in most parts of the country will send a man to the home to measure scientifically the amount of light needed in each room. He will also recommend the type of fixtures needed and the

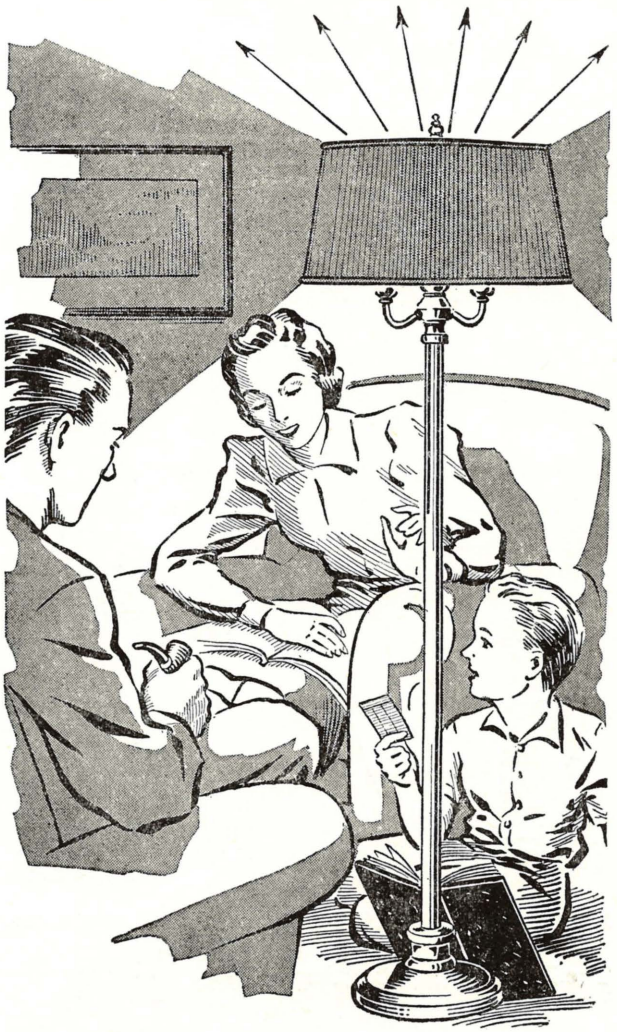


Fig. 334—Floor lamp with indirect reflector

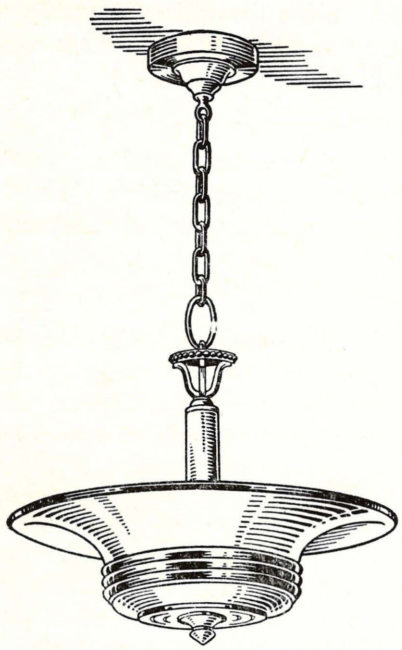


Fig. 335—Dining room light with indirect reflector

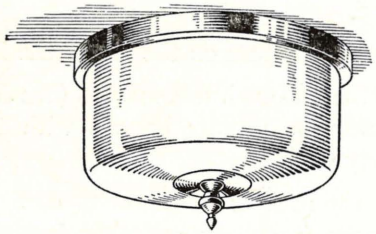


Fig. 336—A good kitchen fixture

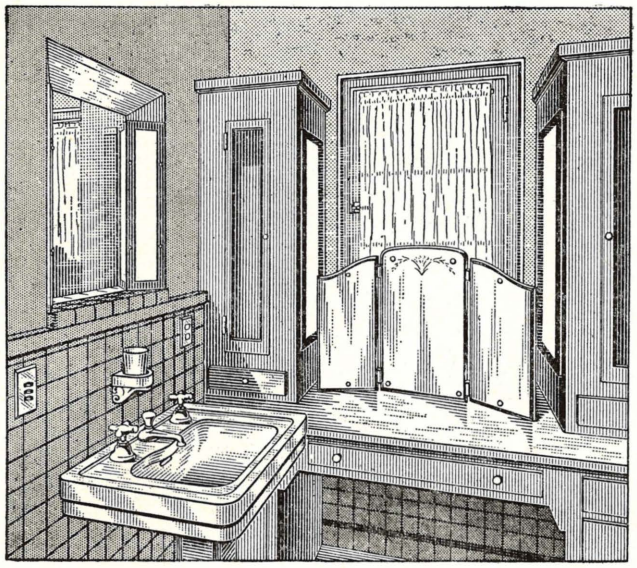


Fig. 336(*a*)—A good fixture for the bathroom mirror

amount of wattage to be used. It is usually much cheaper to have an expert figure the amount of light needed, because he can do it with less wattage than one who knows nothing about it. It is also much easier on the eyes than trying to work or read with poor lights.

The Fluorescent Light

During the past few years the fluorescent light has become popular for home use. A long tube filled with gas is used instead of the usual filament bulb. The fluorescent light gives off a whiter light than the regular light bulb, and operates on less electric current. These lights can be used as regular light fixtures, a special transformer being built into each fixture. The fluorescent light is made in several forms, and has been in use long enough so that the household mechanic should know about them, particularly to be able to change the tubes. This is a simple process which requires no special instruction. The transformer on the inside of the fixture should never be interfered with

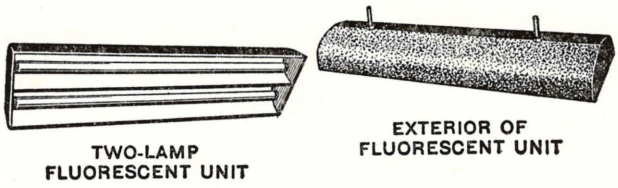


Fig. 337—The fluorescent light has become popular for home use

Fluorescent lighting provides the newest kind of lighting for industrial applications—a light of greater efficiency that enables employes to see more easily and accurately.

Outstanding features of fluorescent lighting units are (1) low brightness—extended light source eliminates annoying glare and shadows; (2) daylight quality—better color discrimination; (3) greater efficiency—more light per kilowatt hour; (4) longer lamp life—fewer lamp replacements; (5) cooler light—less heat radiation; (6) easy to install; (7) easy to maintain.

The benefits of an extended light source are doubled in fluorescent units by the scientifically designed reflector system. Properly maintained, the aluminum reflectors, redirect more than 80% of the accepted light. Highlights and dark spots are minimized.

How Lights Are Wired

Electric lights are almost always wired in parallel. When wired in parallel, as many lights can be used on one circuit as the circuit will carry without overloading. When wired in series, two 40-watt 110-volt lights would burn very dimly, and three might show no light at all. Therefore, lights are never wired in series unless there is some special reason for it.

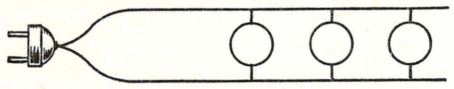


Fig. 338—Parallel wiring

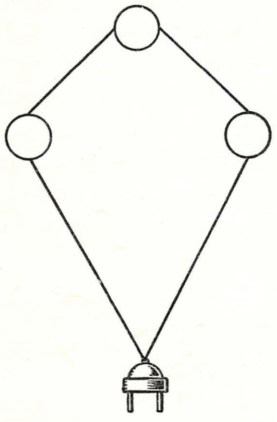


Fig. 339—Series wiring

JOB NO. 68

HOW TO WIRE A LAMP FIXTURE HAVING TWO OR MORE LIGHTS

The household mechanic often has occasion to wire a lamp fixture he has made himself, or to rewire an old one. Since the wiring is usually concealed, it is not easy to see how the wires are connected on another lamp.

Equipment Necessary:

A pair of pliers, a knife, and a screwdriver will usually be enough. Sometimes a piece of stiff wire is needed for running the lamp cord through the base of the lamp.

Materials Necessary:

A wall plug, a piece of lamp cord about ten feet longer than enough to run through the base of the lamp, and a two or three light fixture. The fixtures are usually purchased with the sockets already wired.

Here Is a Plan for Doing the Job. Follow instructions carefully.

1. Run the wire through the base of the lamp. Sometimes it is necessary to run a piece of stiff wire through the base, then fasten the lamp cord to the end of it, and pull it through.
2. Run the end of the lamp cord through the fixture.
3. Install the fixture on the top of the base.
4. Wire the sockets if necessary. (See Job No. 60.) Fixtures are usually bought with the sockets already wired.
5. Wire the sockets to the lamp cord in parallel. One wire from each socket is fastened to each wire of the lamp cord with a pigtail splice.
6. Place cap on fixture.
7. Install wall plug on the other end of the lamp cord. (See Job No. 61.)

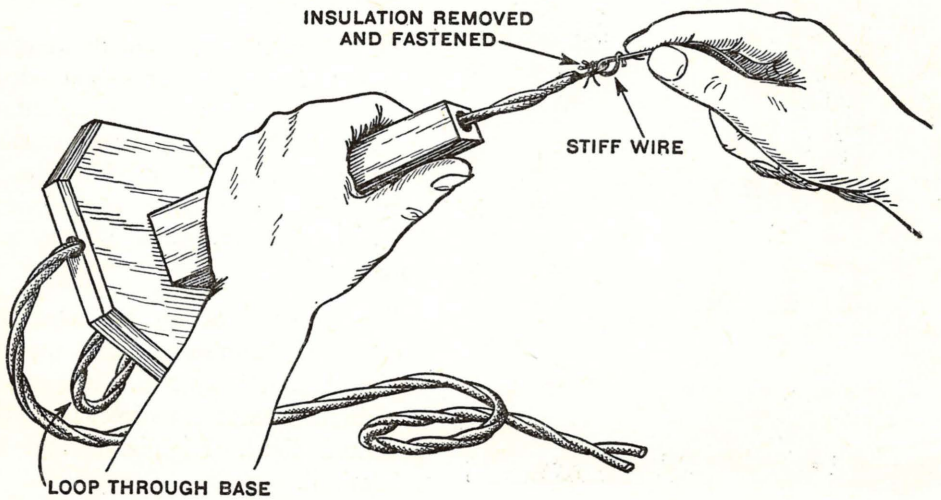


Fig. 340—The lamp cord is run through the base of the lamp

8. Place light bulbs in the sockets and test.

Job Test

1. Were the lights wired in series or in parallel?
2. What kind of splices were used?

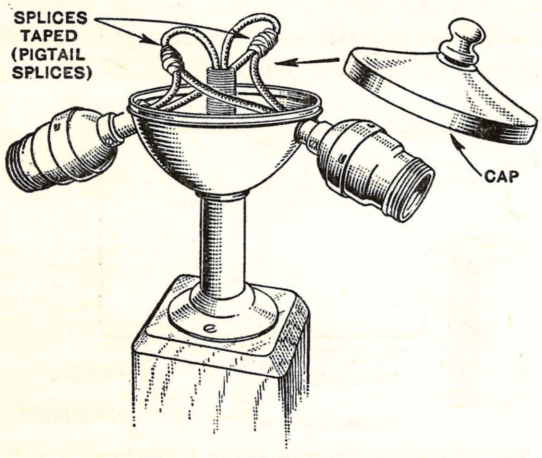


Fig. 341—Wiring a lamp

3. Why was it necessary to insulate the splices?
4. What is the voltage of the ordinary home light circuit?
5. What is the amperage of the ordinary house circuit?

THE ELECTRO-MAGNET

Almost every person has had a bar, or horseshoe magnet, at some time or other, and knows how one works. It is simply a piece of steel, which has been magnetized, and which holds its magnetism. The electro-magnet appears to be much the same, but its construction is quite different. It is made with a core of soft iron, wrapped with insulated copper wire, and will attract iron objects only when connected to a dry cell or other source of direct-current electricity.

The electro-magnet is not just an amusing toy, as it may seem. Without an electro-magnet, the door bell would not operate. The electric motor and the generator depend on the electro-magnet to make them of use to man. Wrecking companies and foundries use the electro-magnet to lift tons of iron which would require much longer if done by any other method.

In making an electro-magnet, soft iron is used for the core because it is easy to magnetize, and instantly loses most of its magnetism when the electric circuit is broken. The wire used in wrapping around the core is insulated copper wire. The number of turns of wire around the core determines how powerful the magnet will be.

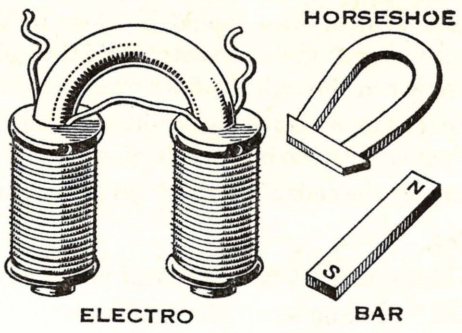


Fig. 342—Magnets

In order to understand an electro-magnet as well as possible you should do some experimenting.

JOB NO. 69

HOW TO MAKE AN ELECTRO-MAGNET

The household mechanic will find it interesting, and also learn something about electricity if he will make an electro-magnet. It can be done with a few simple tools and materials.

Materials Necessary:

A piece of soft iron rod about $\frac{1}{4}''\times5''$, about twenty feet of fine insulated copper wire, and some friction tape. Two fiber washers can be used for the ends of the coil.

Equipment Necessary:

About the only equipment needed is a knife for removing insulation and a pair of pliers for cutting the wire.

Here Is a Plan for Making the Electro Magnet.

1. Place a fiber washer on each end of the iron core. These should fit tightly.

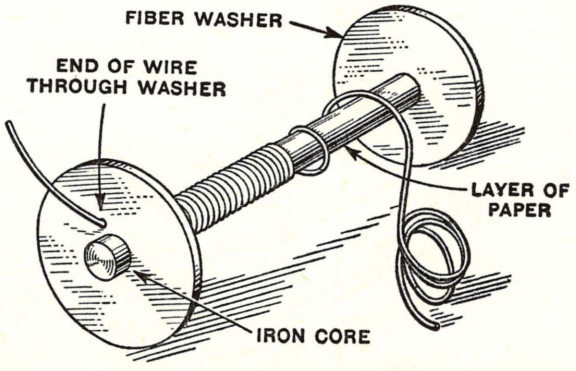


Fig. 343—Wind insulated copper wire around a soft iron core

2. Wrap the iron core between the washers with a layer of paper.
3. Wind the coil neatly with one layer of wire. Each turn of wire should be close to the one next to it. It makes a neater job if the end of the wire is run through the fiber washer at one end.
4. Wind as many layers as possible, putting a layer of paper between each layer of wire.
5. Connect the ends of the wires to a dry cell and test.

Job Test

1. Will the magnet pick up small pieces of iron?
2. Will it pick up small pieces of brass?
3. Will it pick up small pieces of glass or wood?
4. Is there a current of electricity flowing through the coil of the magnet?

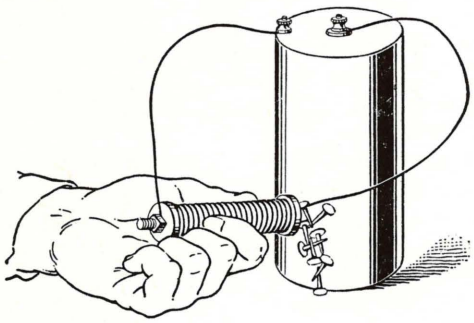


Fig. 344—Picking up iron nails with an electro-magnet

5. Study the next diagram, Fig. 345. Do you think you could make a telegraph set using the same plan?

JOB NO. 70

HOW TO MAKE A TELEGRAPH SET

Here is a drawing of a simple telegraph set. No plan of work is given. See if you can make your own plan of work and construct the set all by yourself.

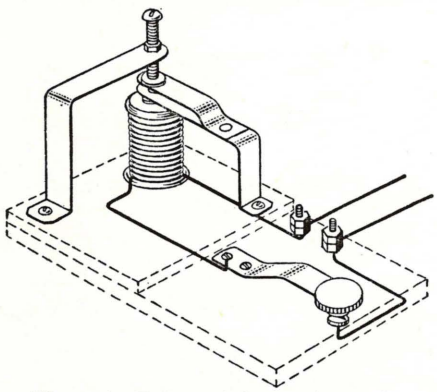


Fig. 345—Telegraph key and sounder

The Door Bell

The electro-magnet, which has been explained in the preceding experiment, is the most important part of a door bell. One other point is necessary to make its working parts complete. That is a device to open and close the circuit rapidly enough to make the hammer strike the bell in rapid succession. This device is called a "circuit breaker."

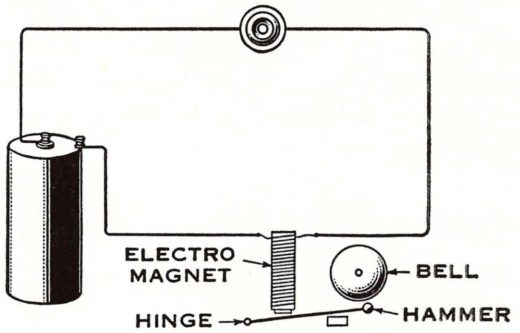


Fig. 346—An electro-magnet can be made to cause a hammer to strike a bell

Here is the way it works. When the circuit is closed by pushing the push button, the electro-magnet of the bell becomes magnetized. The electro-magnet attracts the small piece of iron, called the armature, causing the attached clapper or hammer to strike the bell. When the electro-magnet has drawn the piece of iron to it, it also opens the circuit at the circuit breaker, or in other words, breaks the

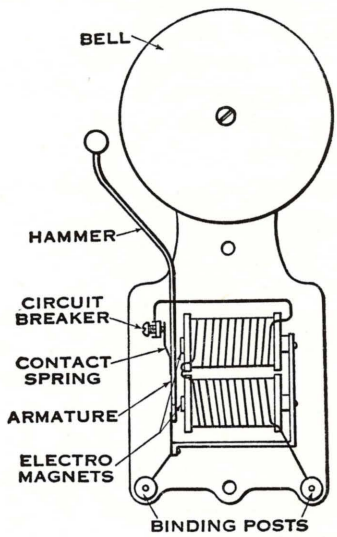


Fig. 347—The door bell and its principal parts

circuit. The instant the circuit is broken, the armature, also mounted on a spring, snaps back into its normal position, closing the circuit once more.

The electro-magnet becomes magnetized once more, and attracts the armature. The armature opens and closes the circuit very rapidly as long as the push button is held down. On more expensive bells, the breaker point is adjustable.

Some small door bells will operate satisfactorily with one dry cell. Others need two dry cells wired in series to make the clapper work fast enough. The working parts in a buzzer are the same as in a bell.

You will be able to understand the bell much better, if you do some experimenting with one. Here are some things for you to do.

A Test on the Door Bell.

1. Wire a door bell with one dry cell and a push button. Press the button.
   (*a*) Does the circuit remain closed while the push button is being pressed?
2. Wire the bell, using two dry cells wired in series.
   (*a*) Does the bell ring louder than before?
   (*b*) Would the clapper move if the dry cells were connected directly to the coils?
   (*c*) Would it move rapidly back and forth?
   (*d*) Where is the circuit opened and closed when the bell is ringing?
   (*e*) What would happen if the circuit were closed at any other point?
   (*f*) What is the purpose of the breaker point?
   (*g*) What would happen if the spring on the armature would not touch the breaker point?
   (*h*) What would happen if the ordinary door bell were connected to the 110-volt house current?
   (*i*) What is commonly used for ringing door bells instead of dry cells?

WIRING DOOR BELLS

The household mechanic often has occasion to wire up door bells and buzzers, or to repair old circuits which do not work. The following jobs are intended to be of help to the household mechanic in doing this.

JOB NO. 71

HOW TO WIRE ONE DOOR BELL WITH ONE PUSH BUTTON AND ONE DRY CELL OR TRANSFORMER

This system is used where only one bell is desired. A buzzer may be used instead of a bell. It is very handy for a dining room bell, or for a door bell where only one is desired.

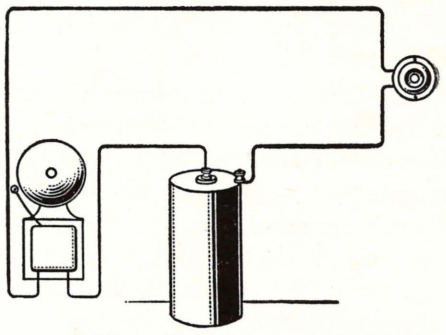


Fig. 348—Wiring diagram for a single bell circuit

Materials Necessary:

A door bell or buzzer, a dry cell or transformer, No. 18 annunicator wire, insulated staples for fastening the wire, and both round head and flat head screws.

Equipment Necessary:

A pair of pliers, a small screwdriver, a drill, and a hammer.

Here is a plan for wiring up this simple bell circuit. Since it is your first, you should be sure to follow instructions carefully.

1. Mount the bell where it is desired. This is usually done with round head screws, because they look better than flat head screws.
   Pilot holes should be drilled into the woodwork for the screws so that they will drive more easily, and will not split the wood.
2. Take the push button apart, and mount it where it is desired. The top should not be replaced until the wiring is attached.

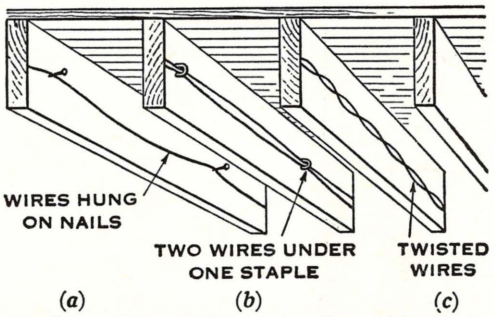


Fig. 349—Some things NOT to do when wiring a door bell circuit. (*a*) Hanging wires on nails. (*b*) Two wires under one staple. (*c*) Twisted wires

3. Place the dry cell or transformer where it is desired. The dry cell should be placed where it is out of the way. It is often placed in the basement.
4. Wire the circuit. When wired on a panel at school, the wires should be placed as they are in the diagram. Notice that they are run in horizontal and vertical lines.

   When a bell is wired at home, the wires should be run along the moldings, and concealed as much as possible.

   Note: Two wires should never be run under the same staple, or even close together. If they are too close, a short circuit may result.
5. Test the circuit. Press the button. If the bell does not ring, remove the cover and adjust the breaker point. If the breaker point does not have a screw for this adjustment, the spring on the armature may be bent one way or the other until it does ring properly.

   The door bell in the home should have at least two dry cells to make the bell ring properly.

Now That You Have Wired a Door Bell at School' Do You Think You Could Do the Job at Home? If you can answer "Yes" to the following questions, there is every reason to believe that you can:

1. Does the bell ring well?
2. Are the wires neatly run?
3. Are the connections neatly made?

JOB NO. 72

HOW TO WIRE A BELL CIRCUIT THAT WILL OPERATE TWO BELLS WITH ONE PUSH BUTTON

Quite often it is necessary to have two bells, or a bell and a buzzer, which will operate with the same push button. Such an arrangement might be used when it is desired to have an extra bell in the bedroom, garage, or basement.

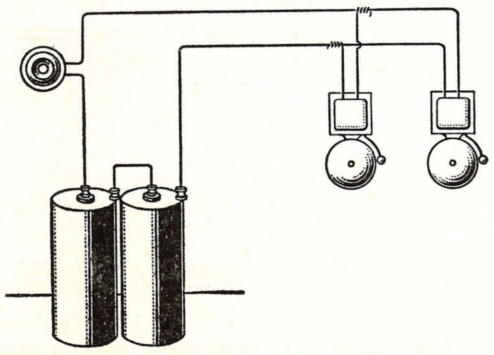


Fig. 350—Wiring diagram of a bell circuit that will operate two bells with one push button

Necessary Materials:

Two bells, or a bell and a buzzer, two dry cells, or a bell transformer, a push button, annunciator wire, staples, and some screws.

Here Is a Wiring Diagram of Two Bells Operated by One Push Button. The bells are wired in parallel. They could be wired in series, but would not be nearly so satisfactory.

1. Wire the circuit as shown in Fig. 350.

Are You Satisfied With the Job You Have Done? Here are some things you should be able to do and know.

1. Trace the current through the circuit as wired.
2. Draw a diagram showing how the bells would be wired in series.
3. What happens when one bell is out of order when wired in series?

JOB NO. 73

HOW TO WIRE A BELL CIRCUIT SO THAT ONE BUTTON WILL RING A BELL AND ANOTHER WILL RING A BUZZER, BOTH USING THE SAME BATTERY

This is the kind of arrangement usually found in the home. The bell announces for the front door, and the buzzer announces the rear door.

Materials Necessary:

One bell, one buzzer, two push buttons, two dry cells or a transformer, annunciator wire, staples and screws.

Here Is the Wiring Diagram. The job is a little more complicated than the previous one, so more care should be used. Follow the diagram closely.

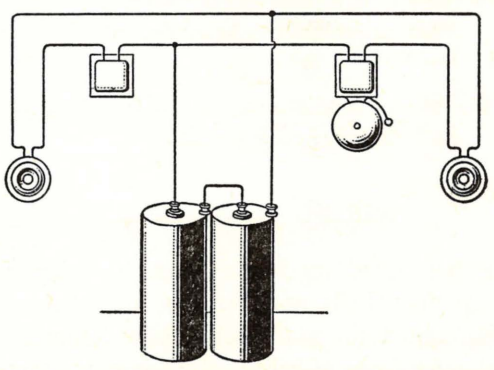


Fig. 351—Diagram of a bell circuit so that one button will ring a bell and the other button will ring a buzzer

1. Wire the circuit, using wiring plan in Fig. 351.

Now That You Have Successfully Completed This Job, Do You Think You Have Learned Anything About Electricity? Here are some questions that may help you find out.

1. Trace the current through the circuit when either button is pushed.
2. What would happen to the bell system if the bell connection became loose?
3. Show the best way to connect a third bell to the circuit. Which button would ring it?

JOB NO. 74

HOW TO WIRE A SYSTEM OF BELLS AND BUZZERS FOR THE FRONT AND REAR DOORS OF A TWO-APARTMENT HOUSE

This job is more complicated than any of the previous bell wiring jobs. It is a very convenient arrangement where there are two families living in the same house.

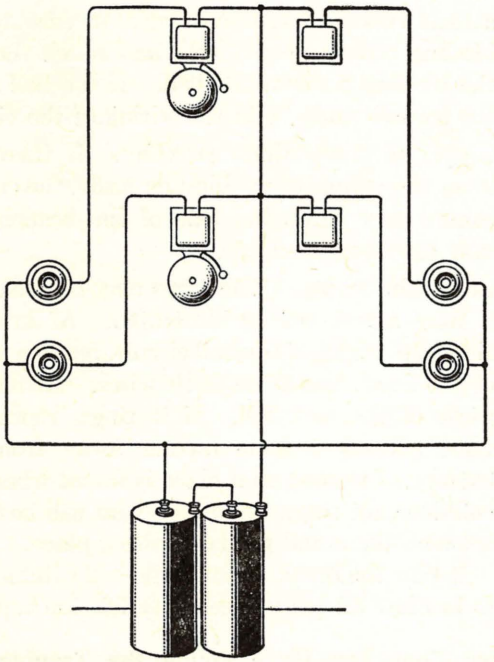


Fig. 352—A wiring diagram for the front and rear doors of a two family apartment house

Necessary Materials:

Two bells, two buzzers, four push buttons, two dry cells or a transformer, annunciator wire, friction tape, screws and staples.

This Job Requires Very Close Attention to the Wiring Diagram. Be sure to follow it closely, or the system may not work properly.

1. Wire up the circuit as shown in Fig. 352. Notice that it is necessary to make several branch taps in the circuit. Consult the job on electrical splices if further information is needed.

Now That the Job Is Completed, It May Be a Good Plan to Show How Much You Have Learned by Answering These Questions.

1. Trace the current through the circuit when any of the buttons are pushed.
2. What would happen if the connection to one of the push buttons became loose?
3. Show by a diagram how more bells and push buttons could be added to the system.

A Short Circuit In a Door Bell Circuit

A short circuit often occurs in a door bell circuit. Wires may have been run too closely together, or some metal object may be touching both wires. When this happens, the short circuit must be found and corrected before the door bell will work. This job will test the skill of the household mechanic.

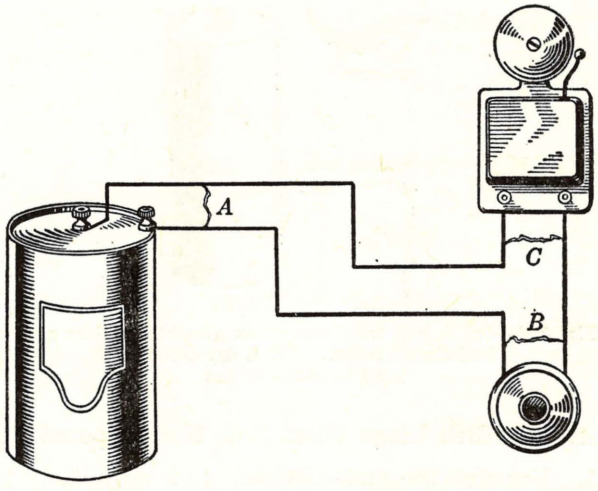


Fig. 353—Three common kinds of short circuits may occur in a door bell circuit, each having a different effect

When a short circuit occurs in a door bell circuit, one of three conditions is usually true. There may be a short at A, or at any place between the source and the push button, or between the source and the bell. When this is true, the wire becomes hot and remains hot until a connection is burned off, the short is removed, or the dry cells become worn out. The bell will not work when the push button is pushed. There may be a short at B, or at any point between the source and the bell where the current would not have to go through the push button. When this occurs, the bell will continue to ring until

the short is removed or the source of electricity is worn out or turned off. There may be a short at C, or in the bell. In this case, the bell refuses to work, and the wires become hot only when the push button is pushed. That is the only time there would be a complete circuit.

JOB NO. 75

HOW TO SHOOT TROUBLE IN A DOOR BELL CIRCUIT

Door bells sometimes get out of order and will not ring, or else ring when they are not supposed to. The ordinary person can find and remedy this difficulty, if he is willing to spend a little time in studying and reasoning things out for himself.

Here Are a Number of Things Which May Be Wrong. Ways to remedy them are suggested. Use the remedy which seems to fit the case.

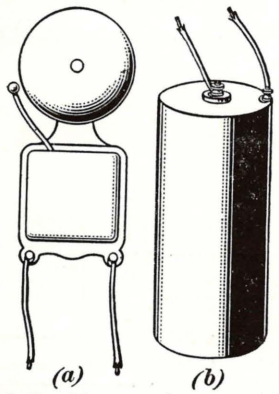


Fig. 354—(*a*) A bell with two wires attached makes a good bell circuit tester. (*b*) A dry cell can be used to test a circuit

A. **The Bell Rings When It Is Not Supposed To.**

1. Examine the push button. It is very likely to be stuck or dirty. Clean and adjust it.
2. The wires which lead to the push button may be short circuited. This may happen if the wires have been run too close together. If this is the case, the bell will continue to ring independently of the push button.

B. **The Bell Will Not Ring.**

1. Test the push button. Sometimes the spring inside the push button is broken, and does not close the circuit when the button is pushed.
2. Check the dry cells. If they have been used for some time they are probably worn out. If a transformer is used in the place of dry cells, a test bell should be connected to it. (See Fig. 355.)

   The dry cell should be checked with a test bell or a volt meter. If a volt meter is not handy, the dry cell may be tested at any hardware store. If the cell is worn out, a new one should be purchased and installed.

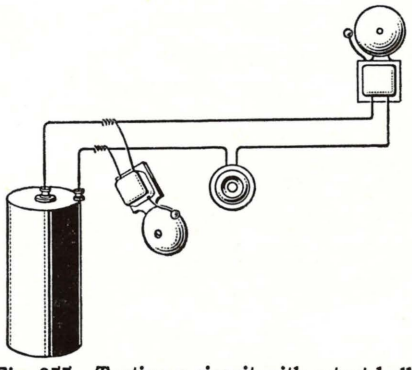


Fig. 355—Testing a circuit with a test bell

3. Check the bell. A good way to do this, is to attach two pieces of annunciator wire to the binding posts of a dry cell, and touch these to the binding posts of the bell. If the bell rings, the trouble must be in the wiring of the circuit.
4. Check all connections carefully. If there is a loose wire at one of the binding posts, the current cannot flow through. One of the branch taps may have become loose.
5. Check the wiring. The wires may be broken.

   Wire a test bell as illustrated. At intervals along the wiring of the bell circuit, remove a little of the insulation from both wires. Attach the wires of the test bell. If it rings, repeat the same process a little farther away from the battery. As soon as a place is found where the bell does not ring, the broken wire will be found between there and the last testing place.

   Repair the break and test the bell. Remember to insulate all bare places with friction tape.

Now That You Have Found the Trouble You Should Be Able to Answer the Following Questions.

1. Does the bell work properly?
2. Is any of the woodwork scarred by the careless use of tools?
3. Are the covers replaced on the bell and the push button?
4. Is bell wire insulated with rubber?
5. Which is more common for operating door bells, dry cells or transformers?

THE ELECTRIC MOTOR

Since the electric motor is the source of power for many electric appliances, the household mechanic should know someting about its care. Motors will last much longer if cared for properly. Repairs on motors are costly, and often impossible to get. The household mechanic should not attempt to repair a motor unless he has had special training along that line. There are, however, many things he can do to make motors last longer.

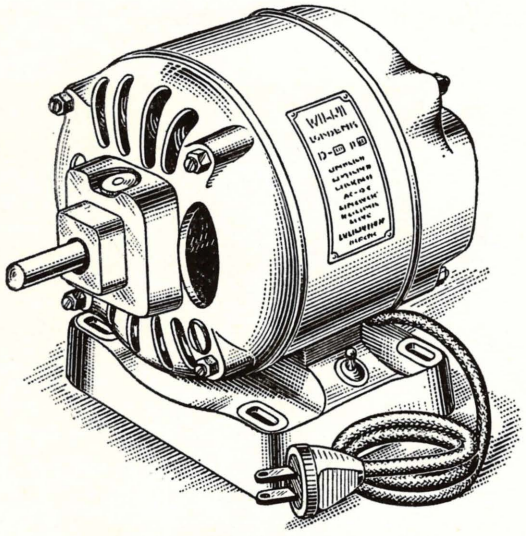


Fig. 356—The electric motor. Note rating plate on the motor

Oiling Motors

Probably more electric motors stop running because of too much oil than because they have not been oiled enough. When oiled too much or too frequently, oil gets on the commutator and makes it gummy, and sometimes even soaks the wiring on the inside of the motor. For this reason, many manufacturers seal the bearings of appliance motors in oil and tell their customers never to oil them. Make sure that a motor has a place for oiling before attempting to oil it. Do not squirt oil on shiny surfaces or through the ventilators on the ends of the motor. With the amount of use the washing machine in the ordinary family gets, the motor should be oiled about twice a year. The fan motor on the furnace needs oiling about once every two months while the furnace is running.

When Motors Become Hot

An electric motor always becomes warm after it has run for a few minutes. This is perfectly normal and need cause no alarm. But when a motor

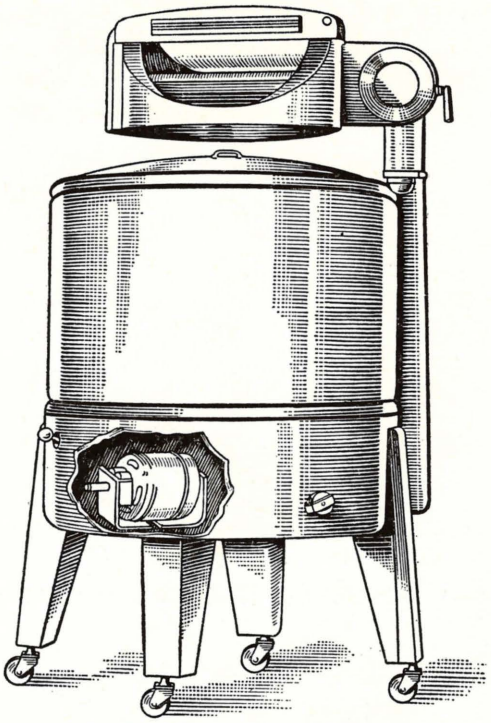


Fig. 357—The washing machine motor needs oiling about twice a year

becomes so hot that it cannot be handled, and when smoke and the odor of burning insulation comes from the inside, there is cause for alarm. This may be caused by several things. The motor may be overloaded. It may have had too much oil, or it may be damp or dirty. Whatever the cause, an electrician should be consulted. It is usually cheaper to do this than to try home remedies and spoil the motor in the end.

Keep Motor Dry

Electric mixers, or other electric appliances should not be washed in water. Only the working parts which may be removed should be washed. The part containing the motor may be wiped off with a damp cloth, but be sure it is disconnected from the wall outlet before doing that. When the inside of a motor becomes wet, short circuits are formed, and the wiring burns out when it is plugged into the wall outlet. In case of floods, remove all motors which were under water before they are turned on, and have them thoroughly dried out before attempting to use them. The electrician will put them in an oven and bake them until they are thoroughly dry.

Keep Motors Clean

Dust and lint are the worst enemies of electric motors. They get into the brushes and commutator

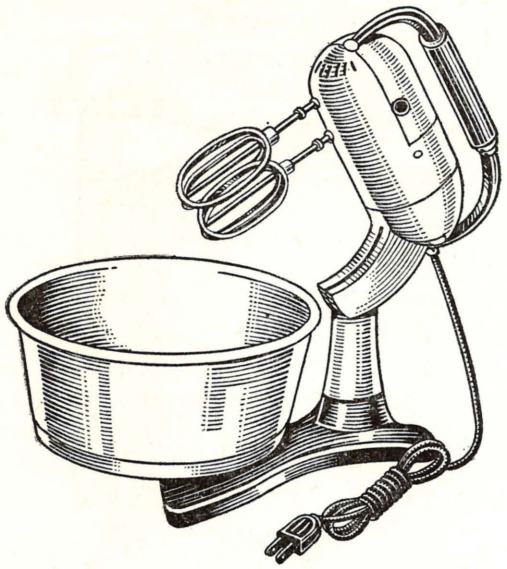


Fig. 358—The electric mixer should not be washed in water

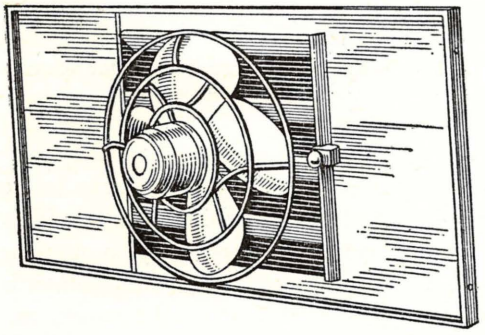


Fig. 359—All electric appliances must be kept clean

causing excessive wear. They get into the wiring, causing the motor to heat. Dust and lint should be blown out of the inside of the motor occasionally with a bicycle pump. When motors are used in dusty places, they should have some kind of screen protection. They cannot be covered with cloth, because they need air to keep them cool.

Use Motors Reasonably

In the first place, be sure the motor is strong enough to do the job. If you do not know, an electrician should be consulted. Motors should be fastened firmly to a base, or mounted in such a way that they do not vibrate. Belts should be tight enough to do the work, but not tight enough to burn out a bearing. In other words, there is a lot to know about installing and repairing motors, and it is usually best to have them installed by an electrician when there is any doubt. This is often the cheapest procedure in the end.

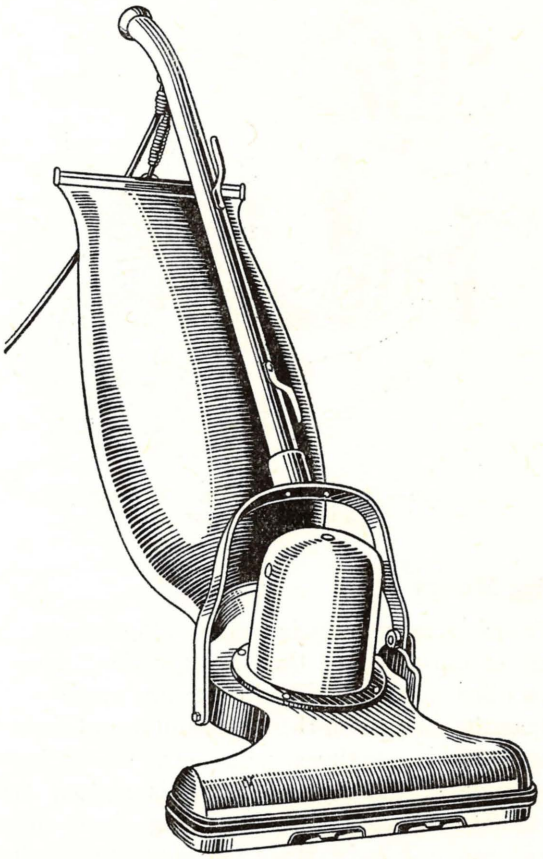


Fig. 360—Appliance motors must be kept clean

Water Supply and Waste Disposal

Chapter 5

PURE drinking water and a safe means of disposing of sewage have come to be of great importance in this modern age. They are of special importance in cities where many people live in a small area. But even in small communities, the cottage at the lake, or the farm home, they are of great importance. In cities, the water supply and sewage disposal are supervised by the Board of Health. Small towns or lake resorts are not apt to have any such local organization. In farm homes, the water supply and sewage disposal must be taken care of by the farmer himself. However, most states have a Department of Public Health, whose services are free to the public. This department will analyze samples of drinking water, give advice on water supply and sewage disposal, and send literature on the subject. The state furnishes these services to the public because it realizes the importance of pure drinking water, and the danger of not having a safe means of disposing of sewage. Many contagious diseases are contracted through the use of impure drinking water. Remember: Water may taste good and still be impure.

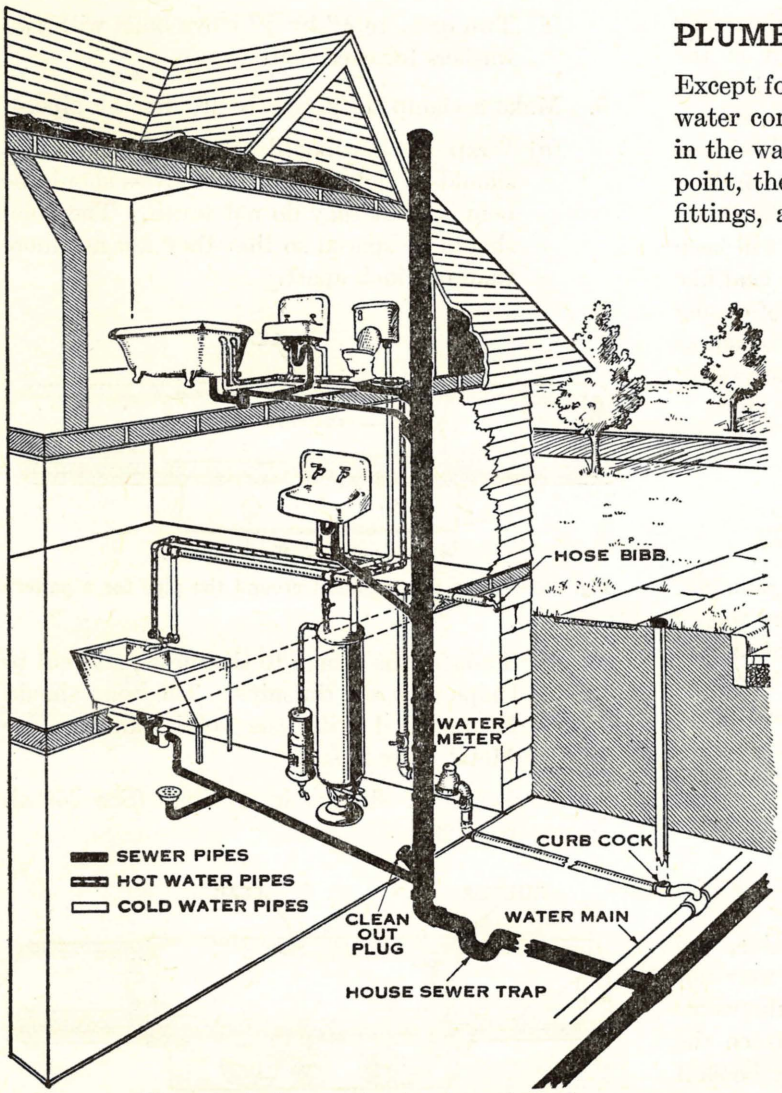


Fig. 361—A diagram showing the water and sewerage disposal lines in a modern house

PLUMBING FIXTURES

Except for installing the water meter, the job of the water company ends when the connection is placed in the water main in front of the house. From this point, the plumber installs the necessary pipe, pipe fittings, and plumbing fixtures. Usually, it is not wise for anyone except a plumber to attempt to install plumbing fixtures. The investment in special tools necessary, and the amount of pipe wasted, would be worth more than the cost of having it installed by an expert plumber. Not many home repairmen know enough about plumbing to do a good job. There are many rules and tricks of the trade known to plumbers that the person in any other walk of life does not know. Furthermore, most cities have an ordinance requiring inspection of new plumbing. This is to prevent unsanitary conditions due to plumbing which has not been installed properly.

Plumbing fixtures often need attention when it is not convenient for the householder to call a plumber. In such cases one may be spared great inconvenience by knowing enough about plumbing to make emergency repairs. Water is often wasted in unbelievable quantities because of leaky pipes and faucets. Leaks often make it necessary to have houses replastered. A little knowledge of plumbing will enable one to get a great deal better service from the plumbing in

the home. Therefore, some of the important plumbing fixtures will be studied carefully.

Water Pipe

Water is carried from the water main and through the house by means of pipe made of lead, galvanized iron, brass, or copper.

Years ago, lead pipe was used exclusively. When manufacturers learned to make galvanized-iron pipe, it replaced the lead because it was cheaper and would stand more rough usage. Plain iron pipe was not satisfactory because of rust. Lead pipe is still used to carry the water from the water main into the house.

Galvanized-iron pipe is the most common pipe found in the average home. It is made in a number of sizes. The size used in the home varies from $\frac{1}{2}''$ to 1″.

During the past few years, copper and brass pipe has been made cheap enough to be used in the average-sized home. Although the first cost is more, it is no more expensive in the end than galvanized-iron pipe, because it lasts much longer, and because the cost of installing copper pipe is much less. There are no threads to cut, and all fittings are soldered. It is also said that copper pipe will keep water hot longer because it does not radiate heat like galvanized-iron pipe. Another advantage of copper pipe is that it is not as apt to burst when frozen as galvanized-iron pipe. Copper is softer and stretches. Repeated freezings, however, will burst the pipe.

JOB NO. 76

HOW TO REPAIR A LEAKY PIPE

Usually, the best thing to do is to call a plumber. The pipe will have to be replaced, and the sooner it is done the less damage it will do to the house. Leaks may be caused by several things. The pipe may be rusted through, it may have burst due to freezing, it may have been damaged by a blow, or it may leak around one of the joints. In any case it is serious.

This Procedure Is a Good One to Follow:

1. Locate the leak.
2. Trace the pipe back to the nearest valve, and shut off the water. By doing this, it may not be necessary to shut off the water for the whole house. In case it is impossible to trace the pipe to a shut-off valve, the water may be shut off at the water meter.
3. Call a plumber.
4. If the plumber is not available within a reasonable time, it is a simple matter to make a clamp to fit over the leak. Then the water may be turned on again until the plumber arrives and replaces the pipe.
5. Get the following materials:
   (*a*) A piece of cardboard to be used as a pattern. It should be long enough to circle the pipe plus two $\frac{1}{2}''$ flanges, and wide enough to cover the leak.
   (*b*) A piece of sheet metal the same size as the cardboard.
   (*c*) A piece of sheet rubber to wrap around the pipe under the clamp. It should cover the hole.
   (*d*) Two or more $\frac{1}{8}''$ by $\frac{3}{4}''$ stove bolts with two washers for each bolt.
6. Make a clamp to fit tightly around the pipe.
   (*a*) Wrap the cardboard around the pipe. It should fit tightly, and the flanges should be bent so that they do not touch. The holes should be spaced so that they are not more than one inch apart.

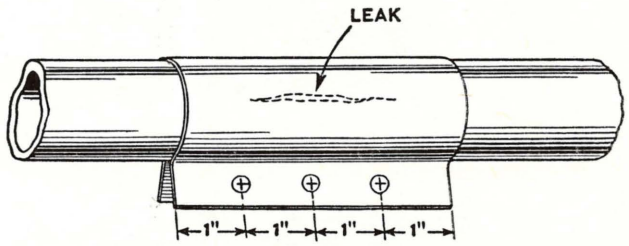


Fig. 362—Wrap the carboard around the pipe for a pattern

   (*b*) Transfer the design to the metal, and cut to shape with the tin snips. The holes should be punched with the solid punch. (See Metal, page 29.)
   (*c*) Form the flanges in a vise. (See Metal, page 29.)

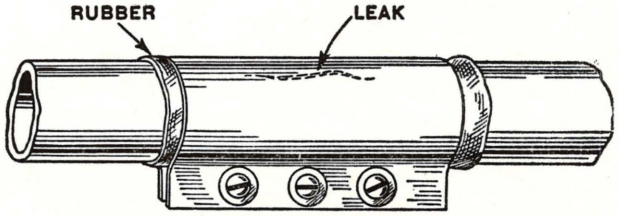


Fig. 363—The pipe clamp installed

(*d*) Form clamp around pipe by hand.

(*e*) Wrap rubber around pipe and over hole.

(*f*) Place clamp over rubber.

(*g*) Insert bolts with a washer on each side of the flange, and tighten. If this does not stop the leak, wrap more rubber around the pipe.

JOB NO. 77

THAWING OUT FROZEN PIPE

Pipe which is frozen has to be thawed out before the plumbing system will function. It is sometimes thought that thawing bursts pipe. This is not true. Bursting takes place when the pipe freezes. When the ice is melted, water comes out the openings caused by freezing. However, pipe does not always burst when frozen.

Here Are Some Suggestions on Thawing Out Frozen Pipe.

1. Locate the shut-off valve controlling the water in the pipe. It may be necessary to use it in a hurry when the ice melts.
2. Open all faucets and valves connected to the pipe line.
3. Apply heat to the frozen portion of the pipe nearest the fixtures.
   (*a*) Heat applied with a blow-torch is dangerous, and should be done very carefully. There is danger of burning the woodwork and causing a very serious fire.
   (*b*) Wrap an electric pad around the pipe. **Caution:** Do not touch pad or pipe after electricity has been turned on. This is a very satisfactory method.
   (*c*) Cloths wet with boiling water may be used. Care should be taken not to damage wall paper or paint.
   (*d*) A lighted candle is sometimes used. The same dangers are present as in case of the blow-torch.

Pipe Fittings

Pipe is fastened together by means of fittings made in many standard shapes and sizes, and for many purposes. They save the plumber many hours of labor, since they are purchased already sized and threaded. The fittings for copper pipe are not threaded because they are to be soldered to the pipe. The pipe fittings visible in the ordinary house will probably number at least a dozen different kinds. The nipple, for instance, is simply a short piece of pipe threaded on both ends, and used between two other fittings.

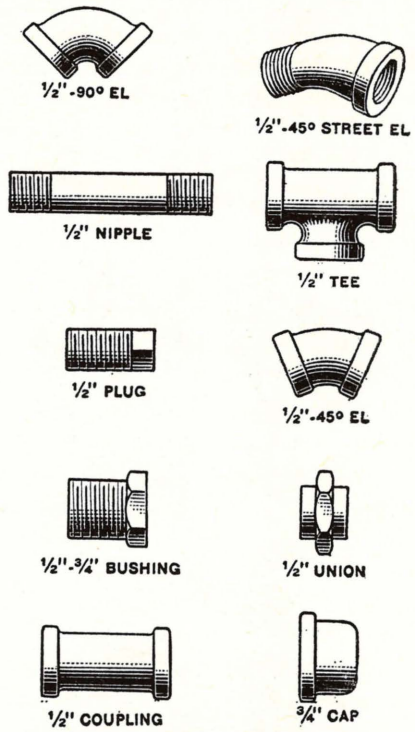


Fig. 364—Threaded Iron Pipe Fittings

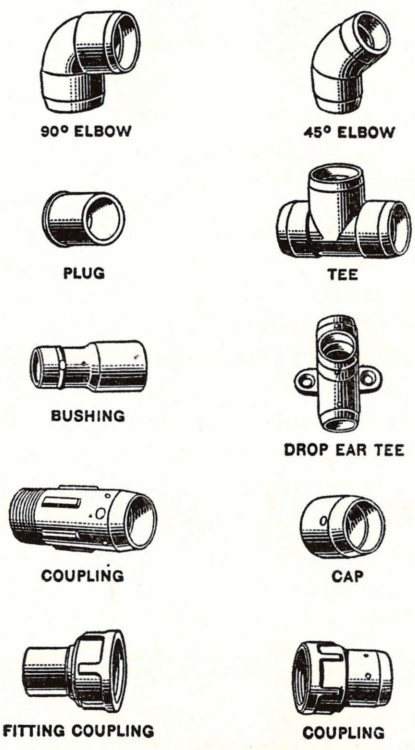


Fig. 365—Copper Pipe Fittings

One of the most important of these common pipe fittings is the union. A union is placed in a line of pipe in such a position that it will not be necessary to remove the entire pipe system in order to replace a particular piece. All plumbing fixtures are fitted with union type connections. The reason for this is that the union can be taken apart and the fixture removed without disturbing any other pipe. Close inspection of the water meter will show one of these unions on either side.

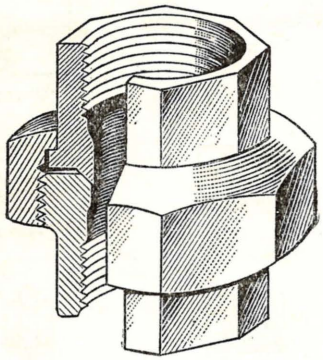


Fig. 366—Ordinary union

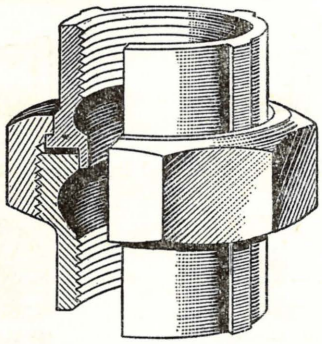


Fig. 367—Gasket type union

The ordinary union, Fig. 366, has a ground joint which fits accurately enough to make it water tight. The union above the water meter, Fig. 367, has a washer or gasket. This gasket becomes soft in hot water, but is not effected by cold water. In case the hot water in the tank becomes too hot, and steam backs up in the pipe line, the gasket blows out allowing the steam to escape. Otherwise, the steam pressure might burst the tank, and do serious damage. In case it is ever necessary to remove this union, be sure that the proper gasket is used when reassembling.

JOB NO. 78

HOW TO ASSEMBLE PIPE FITTINGS

Occasionally things go wrong around the house, and the pipes have to be taken apart when a plumber is not to be had. Therefore, it is a good idea to know something about putting pipes together.

Equipment Necessary:

It will be necessary to have at least one, possibly two, pipe, or stilson wrenches. These wrenches have teeth for gripping round pipe. Fittings having square shoulders can be held with the ordinary monkey wrench, or in a vise.

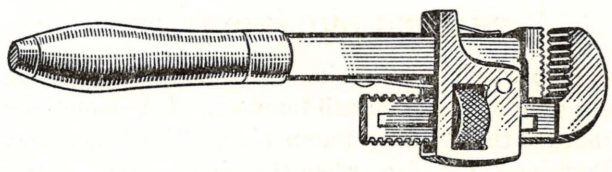


Fig. 368—Stilson wrench

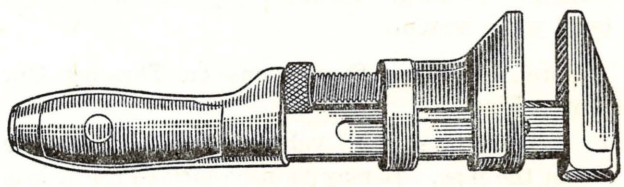


Fig. 369—Monkey wrench

Here Is a Plan For Assembling Some of These Standard Fittings:

1. Secure, and learn by name, the following fittings:
   - (*a*) $\frac{1}{2}''$ coupling
   - (*b*) $\frac{1}{2}''$ nipple (5 required)
   - (*c*) $\frac{1}{2}''$ tee
   - (*d*) $\frac{1}{2}''$ plug
   - (*e*) $\frac{1}{2}''$ 90° el
   - (*f*) $\frac{1}{2}''$ union
   - (*g*) $\frac{1}{2}''$ 45° el
   - (*h*) $\frac{1}{2}''$ 45° street elbow
   - (*i*) $\frac{1}{2}''$ to $\frac{3}{4}''$ bushing
   - (*j*) $\frac{3}{4}''$ cap
2. Assemble these fittings shown in Fig. 364, in the form shown in Fig. 370. Use the stilson wrench to tighten each one, although the unions, plugs and bushings may be tightened with the monkey wrench. In plumbing the fittings are made very tight, but here they should be tightened slightly. This is because they have to be taken apart again. In plumbing practice, the threads are painted with white lead or paint or a special material, to seal the joints and make them water tight. This need not be done in the classroom.
3. Attach the assembly to a water line and test it. This will show whether the joints are tight enough.
4. Turn off the water, drain the pipe, and take the fittings apart.

Did You Do a Good Job? Before deciding on a grade it might be a good idea to answer these questions.

1. Did any of the joints leak when tested?
2. Are any of the fittings badly scarred by the stilson wrench?
3. Could all of the fittings be taken apart easily?

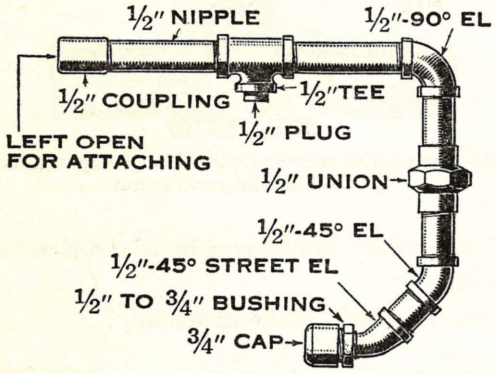


Fig. 370—A pipe line employing the standard pipe fittings

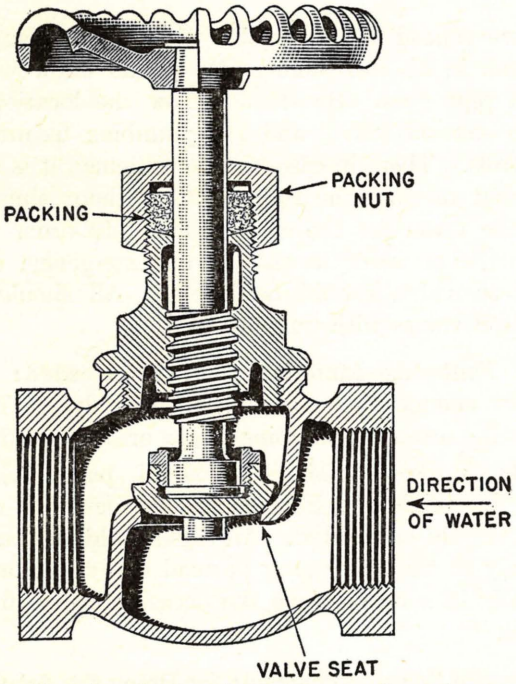


Fig. 371—Section view of compression valve

Valves

A valve is a mechanical device used to control the flow of water in a pipe line. The most common type of valve found in the home is the compression valve, Fig. 372. There is little difference between this type of valve and the compression faucet. The

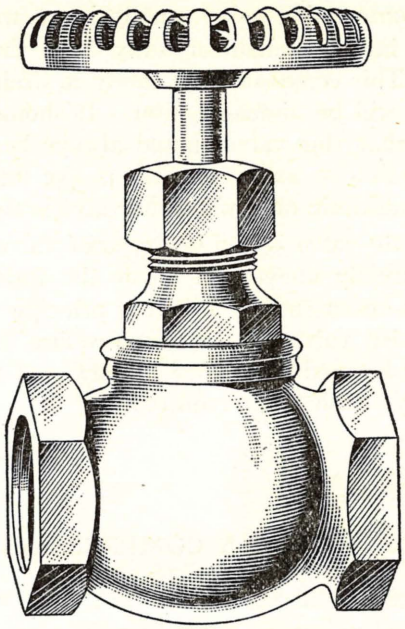


Fig. 372—The compression valve

usual distinction is that water passes through a valve into another pipe, while water is drawn directly from a compression faucet. The working principle is the same, each having a valve stem, valve seat, and packing. While there are some valves with disc washers, most of them have a ground joint which fits tightly enough to make them watertight.

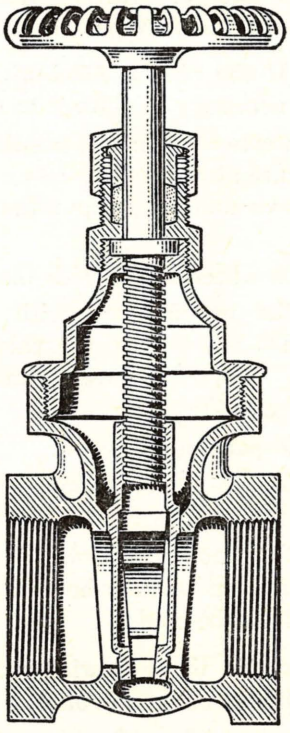


Fig. 373—The gate valve

The compression valve usually has a waste cock opening into the chamber away from the flow of water. This comes in very handy in draining pipe lines, as will be discussed later. It should also be noticed that this valve should always be installed with the flow of water from the proper direction so that it will drain only when the valve is closed.

The gate valve is another type of valve, usually found directly above and below the water meter. It works on an entirely different principle than the compression valve. A gate, controlling the flow of water, is lowered and raised by means of the valve stem. No washers are required.

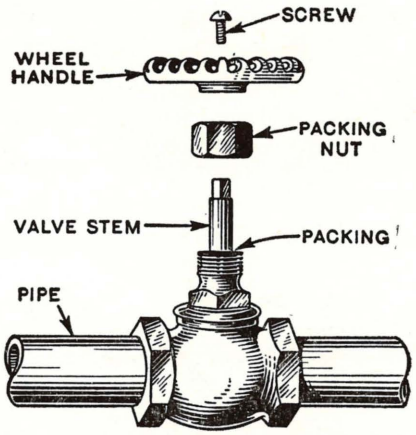


Fig. 374—The packing may be replaced in a compression valve by removing the packing nut

JOB NO. 79

HOW TO REPACK A COMPRESSION VALVE

The packing in valves does not often wear out, because valves are not turned on and off as often as faucets. It does, however, get old and deteriorate, allowing the water to come through. It requires only a few minutes time to repack one.

Tools and Materials Required:

A screwdriver, a monkey wrench, and some valve packing are the only materials needed.

Here Is a Good Procedure to Follow:

1. Be sure to close the valve. Otherwise, water may spurt out when the packing nut is removed.

   Note: If the pipe is filled with hot water, it may be necessary to allow it to cool.
2. Open the waste cock, and, if possible, the faucet on the fixture at the end of the pipe line. This prevents a vacuum, and allows the water to run out freely.
3. Remove the wheel handle with the screwdriver.
4. Remove the packing nut with the monkey wrench. Do not remove the valve stem from the valve. It is not necessary, and necessitates the draining of the pipes.
5. Replace old packing with new.
6. Reassemble the valve, making sure that the packing nut is tight. Close the waste cock.
7. Turn on the water and test. If it still leaks, the packing nut should be tighter, or more packing should be used.

The Answers To the Following Questions Will Indicate the Quality of Your Work.

1. Does the valve still leak?
2. Is the packing nut scarred by the careless use of tools?
3. Does the wheel handle turn easily?

JOB NO. 80

HOW TO TAG THE SHUT-OFF VALVES

Everyone should be familiar with the water supply system in his own home. He should know where each pipe goes. He should know the location of each shut-off valve, and the plumbing fixtures it controls. Then, in case of an emergency, it is easy to shut off just the right valve without shutting off the water for the entire house. In order that there be no error in case of an emergency, each shut-off valve should be labeled. All should be shut-off valves with waste cocks.

The Following Materials Will Be Needed:

Get enough tags for all shut-off valves. They may be ordinary shipping tags, or they may be made of sheet metal. (See Metal, page 24.) If they are made of a kind of metal affected by rust, they should be painted. All tags should be marked plainly so that they may be read easily, for one is usually in a hurry when the occasion arises to use them.

Here Are Some Suggestions for Doing the Job:

1. Find out what part of the water supply system each valve controls. A good way to make sure, is to shut off a valve and then go upstairs and turn on faucets until those affected are found. Do not forget to turn the valve on again.
2. Mark plainly on the tag, the part of the water supply system controlled by the shut-off valve.

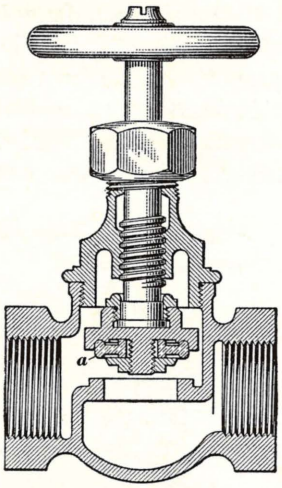


Fig. 375—A shut-off valve

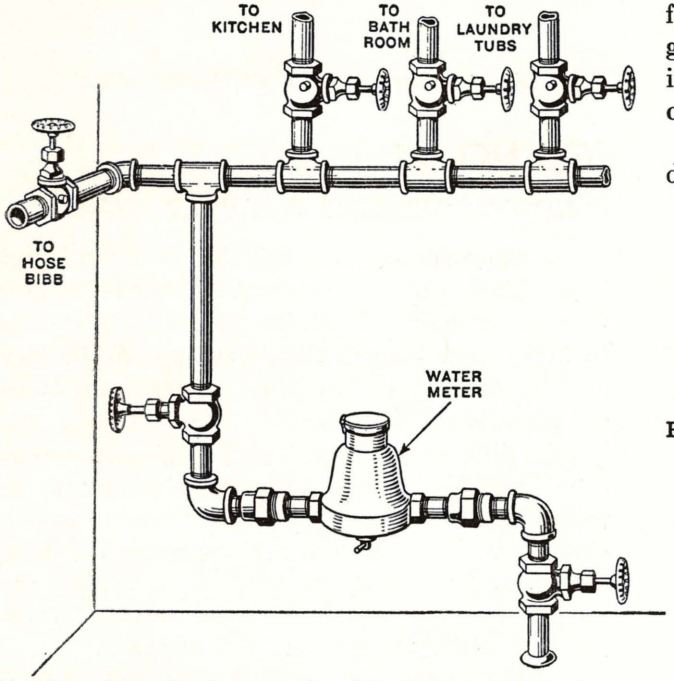
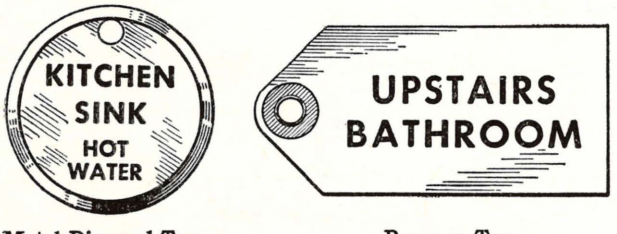


Fig. 376—Shut-off valves are placed in the pipe lines in the basement so that the water can be shut off and drained from any plumbing fixture



Metal-Rimmed Tag Baggage Tag

Fig. 377—Suggestions for tags

3. Tie this tag on the valve handle.
4. Label all valves in this manner.

Faucets

A faucet is a valve used to control the outlet of a water pipe. A faucet may also be called a bibb or a cock. A nickel or chrome-plated brass faucet is usually considered the best grade. However,

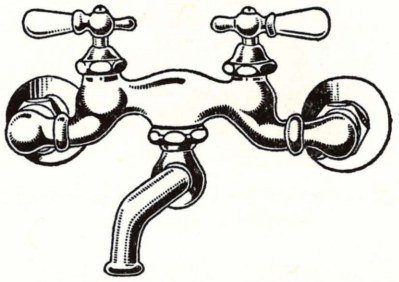


Fig. 378—Combination sink or laundry bibb for drawing both hot and cold water

faucets used in the laundry, or for attaching the garden hose are plain brass. Brass is used because it does not rust. Less expensive faucets are made of white metal.

The shape and style of handles have nothing to do with the working parts of the faucet. Hose

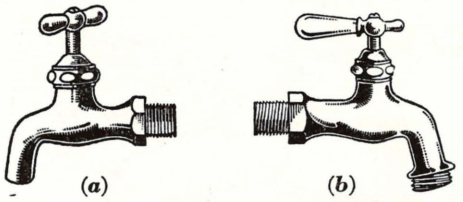


Fig. 379—(*a*) Compression sink bibb, plain nozzle, nickel finished. (*b*) The hose bibb has the nozzle threaded for attaching hose or water filter

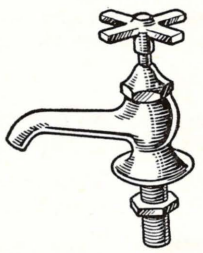


Fig. 380—Basin cock, used in lavatories

bibbs have threaded nozzles. Some faucets are double, permitting both hot and cold water to be drawn through them. The handles are often indexed "HOT" or "COLD." Sometimes the handles are made of colored porcelain to match tiling or inside paint. The hot-water faucet is always placed on the left and the cold on the right.

All faucets installed nowadays are compression-type faucets. This means that the flow of water is controlled by a disc washer which is pressed

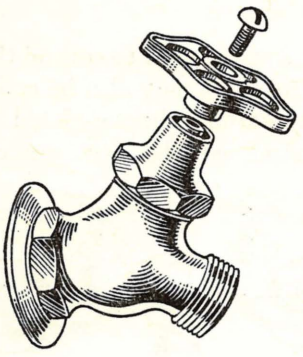


Fig. 381—Sill cock for attaching the garden hose outside of the house

against a valve seat. The faucet is opened by turning the valve stem which draws the disc washer away from the seat. It is closed by turning the valve stem in the opposite direction, which forces the washer down onto the valve seat.

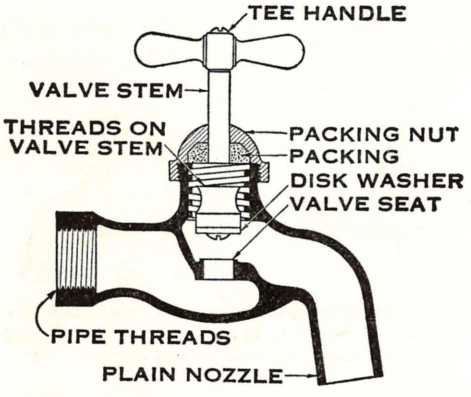


Fig. 382—The section view of a compression faucet showing the working parts. Valve open

Through constant use the disc washer wears out, and will no longer hold the water pressure. Water drips from the nozzle. It is then necessary to replace the washer. New disc washers may be purchased at the hardware store. Sometimes the valve seat becomes worn or rough and will wear out a new washer in a few days. It is then necessary to reseat the valve or buy a new faucet. The valve may be reseated with a tool called a reseating tool.

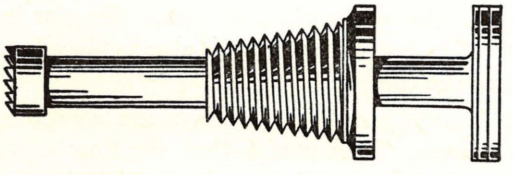


Fig. 383—A valve reseating tool

A new type of compression faucet has recently been placed on the market. It is called the Chicago faucet. It does not need to be reseated, because the valve seat is inside of a removable bushing. When the valve seat becomes worn, a new bushing may be purchased and the old one removed.

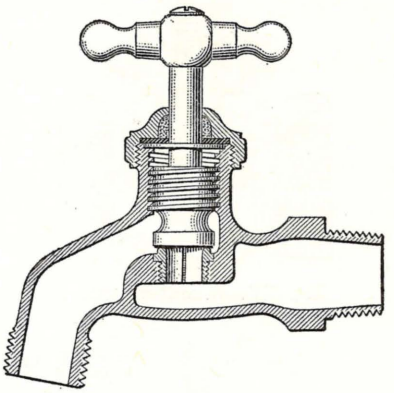


Fig. 384—Section view of the Chicago faucet

JOB NO. 81

HOW TO REPLACE A FAUCET WASHER

Has the sound of water dripping from the faucet in the kitchen or the bathroom at your home ever worried your mother? Mothers usually have enough to worry them without that, and they will be very grateful to you if you prove yourself mechanic enough to repair the faucets.

You Will Need Very Few Tools. The screwdriver and the monkey wrench are about all of the tools that are needed. It is a good plan to have a cloth to wrap around the packing nut while using the monkey wrench, to prevent scratching the faucet. Another way is to place sheets of cardboard or lead inside the jaws of the wrench.

You Should Have the Following Supplies: Disc washers, made especially for faucets. However, emergency repairs can be made with leather or rubber discs for washers.

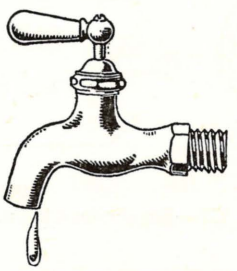


Fig. 385—When water drips from the nozzle of a compression faucet, the washer needs replacing

Here Is a good Plan for Replacing a Washer In a Compression Faucet: If you check each step as you complete it, you will be less likely to skip something important.

1. **To Avoid an Accident, Always Do This:** Locate the shut-off valve and shut off the water. A mess in mother's kitchen gives you a bad start.
2. Remove the valve stem, after unscrewing the packing nut with a monkey wrench. The faucet should be partly opened and kept in that position so that the threads do not become stripped. (See Fig. 386.)
3. Replace the washer by removing the screw on the end of the valve stem. Sometimes the old washer may be turned over and used again.
4. Assemble the faucet. While the packing nut is being turned down, the faucet should be partly opened. When the nut has been turned down

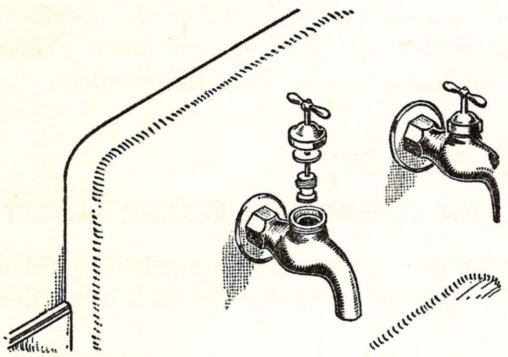


Fig. 386—The body of the compression faucet remains on the water pipe, and the handle remains on the valve stem

firmly, but not tightly, the faucet should be closed.

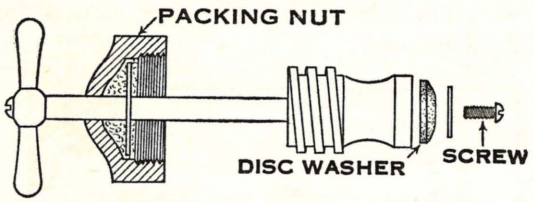


Fig. 387—Replacing worn out washer

5. Turn on the water. Open and close the faucet several times. If the handle turns too hard, loosen the packing nut. If it leaks around the valve stem, tighten the packing nut.

Have You Done a Good Job? If you have, the answer will be "no" to each of these questions.

1. Does the faucet leak?
2. Does it operate with difficulty?
3. Is the finish marred by the careless use of tools?

JOB NO. 82

HOW TO REPACK A COMPRESSION FAUCET

It is very annoying to have the water spurt out around the valve stem of a faucet when the water is turned on. This can be remedied by the household mechanic in a few minutes.

If water leaks out around the valve stem while the water is turned on, the packing under the packing nut needs replacing. Packing in the form of a moulded washer or in the form of rope can be purchased at the hardware store. Oiled cotton string may be used in an emergency, but will not last very long.

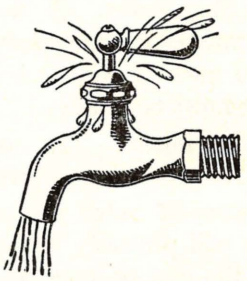


Fig. 388—When water spurts out from around the valve stem the packing needs replacing

You Will Need Only a Few Tools. The screwdriver and the monkey wrench will do very nicely. It is a good plan to protect the finish on the packing nut by wrapping a cloth or adhesive tape around it to prevent scratching. Another way is to place sheets of cardboard or lead inside the jaws of the wrench.

Here Is a Good Plan for Repacking a Compression Faucet. If you check each step as you complete it you will be less likely to skip something important.

1. Secure the necessary packing. Regular molded packing may be purchased at the hardware store, or it may be purchased in the form of rope. Oiled cotton string may be used in an emergency, but will not last long.
2. Locate the shut-off valve and shut off the water.
3. Remove the handle from the valve stem with the screw driver.
4. Remove the packing nut with the monkey wrench, being careful not to mar the finish on

the faucet. Notice that the valve stem is not removed from the faucet.

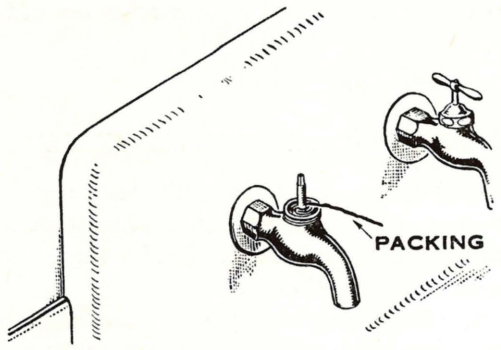


Fig. 389—Packing should be wrapped around the valve stem, in the same direction the packing nut is turned down

5. Replace the packing. In some cases, just a little extra packing may be added to that already in the faucet. It should be wound around the valve stem on top of the old packing. If a molded packing washer is used, all of the old packing must be removed.
6. Assemble the faucet. The packing nut will probably have to be turned very tight.
7. Open the shut-off valve and test the faucet. The handle will probably turn with some difficulty until the new packing is worn in. Sometimes the packing nut may have to be loosened.

Have You Done a Good Job? If you have, the answer will be "No" to each of these questions.

1. Does the faucet leak when the water is turned on?
2. Is the finish marred by the careless use of tools?
3. Did you leave a mess in the sink?

The Fuller Faucet

The Fuller type faucet may be found in some of the older houses, but are not sold in plumbing shops nowadays. In the Fuller faucet, the flow of water is controlled by a rubber ball which is pushed against a valve seat by an eccentric, instead of by a washer as in case of the compression faucet.

How To Distinguish Between the Fuller and the Compression Faucet.

The handle of the compression faucet comes to a decided stop when the faucet is closed. The handle of the Fuller faucet may be turned clear around and the water will be turned on and off with each complete turn.

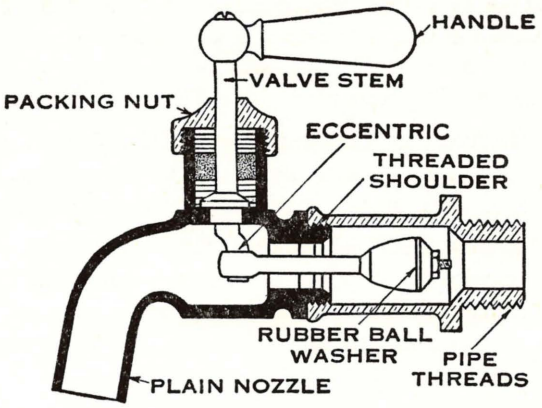


Fig. 390—The section view of a Fuller faucet showing the working parts. Valve open

The valve stem of the compression faucet moves in and out of the body of the faucet as the handle is turned. This is not true with the Fuller faucet.

The Fuller faucet has a threaded shoulder which extends out from the sink. It is at this shoulder that the faucet is taken apart to be repaired. The compression faucet does not have this shoulder.

JOB NO. 83

HOW TO REPAIR A FULLER FAUCET

The Fuller faucet may be repaired by following almost the same procedure as used in repairing a compression faucet.

The Tools Needed: Two monkey wrenches for taking the faucet apart, and a small wrench, or pair of pliers, for removing the nut from the plunger which holds the rubber ball washer.

The only materials needed are a Fuller ball which may be purchased at a hardware or plumbing store, and some packing which is the same as used for a compression faucet.

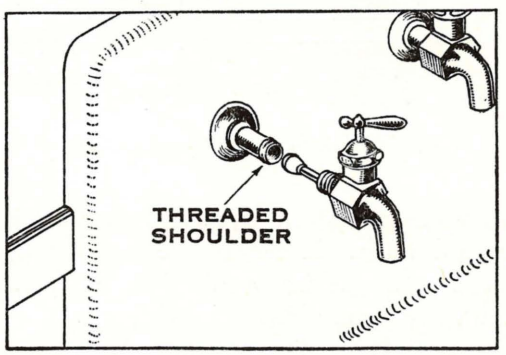


Fig. 391—Fuller faucets are removed from the fixtures by unscrewing them at the threaded shoulder

Here Is a Plan for Replacing a Worn Out Ball. Each step should be checked as usual.

1. Determine where the faucet leaks.
2. Turn off the water.
3. If the faucet needs repacking, see the instructions for the compression faucet. If the ball needs replacing, remove the faucet at the shoulder. A cloth should be wrapped around the faucet to protect it from being marred.
4. Replace the ball, after removing the nut on the end of the plunger. (See Fig. 392.)
5. Assemble the faucet and operate it in the hand to see that it works properly before putting it back on the threaded shoulder. Then proceed as for a compression faucet.

Have You Done Your Work Well? You can judge by answering these questions.

1. Does the faucet leak?
2. Does it work smoothly?
3. Is the finish marred by the careless use of tools?

The Rattling Noise in Water Pipe and Faucets

The rattling noise in faucets or valves is usually caused by a loosely-assembled part. Therefore, if

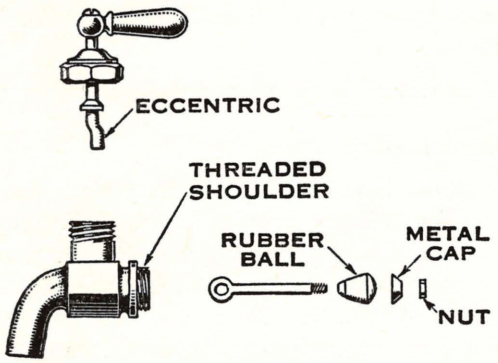


Fig. 392—The rubber ball washer and the packing can be replaced after the faucet has been removed at the shoulder

a faucet is properly assembled it should not rattle. Sometimes, however, the rattle is caused by the water pipe vibrating against the inside of the wall, or against a floor joist. If the place where it strikes can be reached, a piece of wood or cloth may be forced between the pipe and wall or joist. If the place cannot be reached, there is very little that can be done about it.

Flushing Tanks

The flushing tank is a reservoir which holds enough water to cleanse the toilet bowl. The water is held in the tank at the outlet valve by a hollow rubber ball. The water enters the tank through the supply valve, which is similar in construction to the compression faucet. The main difference is that this supply valve operates by means of a copper float which closes the valve as the water level raises in the tank, and opens the valve when the water is released.

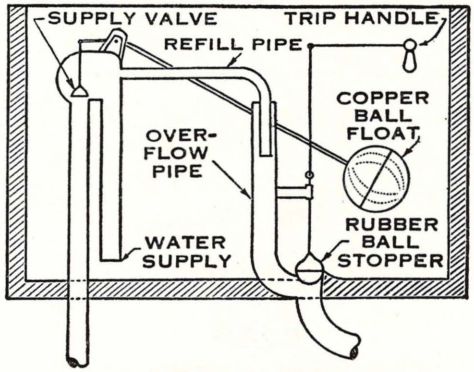


Fig. 393—Diagram of a flushing tank showing the operating parts

JOB NO. 84

HOW TO REPAIR A FLUSHING TANK

After a flushing tank has been used for a number of years, some of the parts wear out and need replacing. It is very annoying, as well as wasteful to have the water running continually. Some repairs can be made by the household mechanic, if he is willing to take the trouble to study the mechanism and see how it works. Other repairs should be left entirely to the plumber.

Two Kinds of Repairs Often Become Necessary.

The Rubber Ball Stopper for the Outlet Valve Needs Replacing. The rubber ball stopper becomes water soaked and "punky" after months of use. The rubber loses its "life." It is necessary then to put in a new rubber ball stopper.

If this is the trouble, one of the following things will be noticed:

Water will not stay in the flushing tank.

The rubber ball stopper will not release the water.

Water runs slowly through the bowl.

How to Replace the Rubber Ball:

1. Shut off the water at the stop and drain cock in the basement (see compression faucet) and flush the toilet.

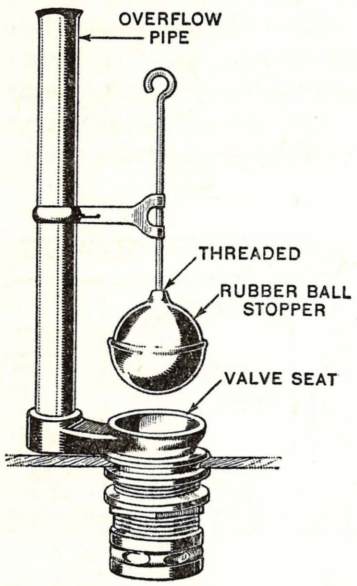


Fig. 394—The rubber ball stopper holds the water in the tank

2. Unscrew the old ball from the rod on which it is suspended and replace it with a new one. Wipe out the valve seat with a cloth.
3. Turn on the water and test the flushing tank. The new ball will work better after it is used a few times.

The Supply Valve Leaks. There are two main causes for this trouble. Either the valve is dirty, or the float needs adjusting. If the valve seat is leaking, one of the following things will be noticed:

A small stream of water keeps running through the bowl.

The float does not shut off the water from the supply valve.

The flow of water may be stopped by lifting the float.

The tank fills and water flows out through the overflow pipe. A little red ink in the tank will soon show up in the bowl.

Here Is the Way To Repair It:

1. Bend downward the rod on which the float is attached. If this does not stop the flow of water, the valve itself needs attention.
2. If the valve needs further attention, it must be taken apart. This requires the services of the expert plumber and should not be undertaken by the household mechanic.

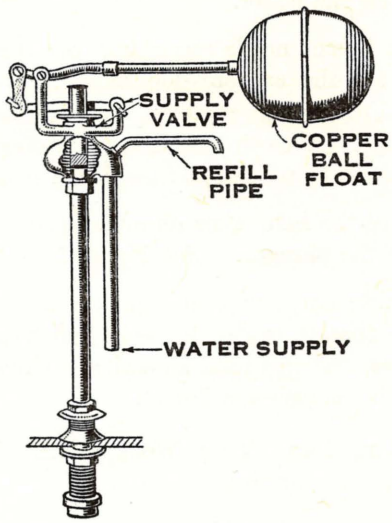


Fig. 395—A float operates the supply valve in the flush tank

These Questions May Help You to Determine How Well You Have Done the Job.

1. Does the float shut off the water when the tank is filled?
2. Will the flushing tank leak when it is full?
3. Does water run continually through the toilet bowl?
4. Does water escape through the overflow pipe?

The Garden Hose

The garden hose is a very necessary piece of equipment in the ordinary private home. It is used for sprinkling the lawn, watering the flowers, washing the family automobile, or scrubbing the basement, garage, or driveway. Since the hose is such a valuable piece of equipment, it should be cared for properly.

Garden hose is made of layers of rubber and fabric. Three-ply hose is the cheapest, and it can be purchased as heavy as six-ply when an especially good hose is desired. The fabric reinforces the hose, enabling it to stand pressure.

After garden hose has been used, it should be rolled up on a hose reel, and the water allowed to drain out of it as it is rolled. It should not be left lying on the lawn in the hot sun. Neither should it be hung on hooks or nails, which break the hose

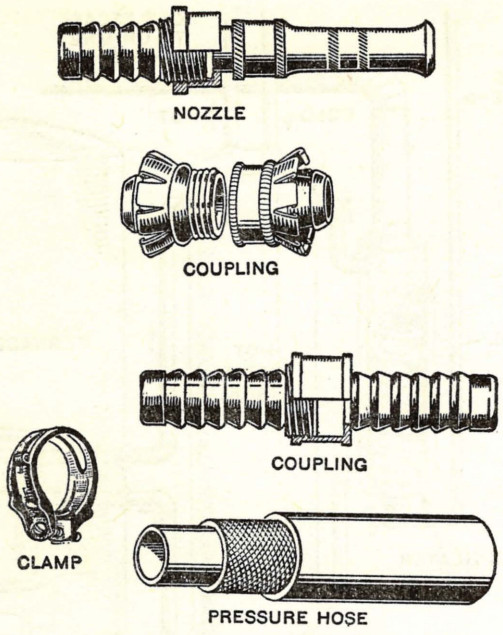


Fig. 396—Garden hose and fittings

in places where leaks later develop. It is the commonly accepted belief that water left standing in a hose rots the rubber. Certainly, water should not be permitted to freeze in the hose in the winter.

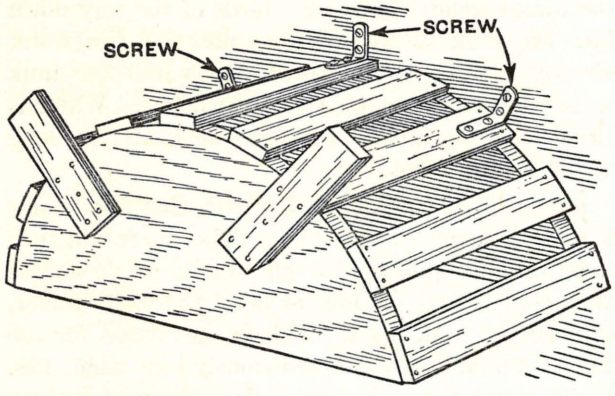


Fig. 397—Home made hose rack for fastening to the garage wall (See Woodworking, page 23)

The garden hose is attached to the sill cock on the outside of the house by means of a threaded fitting which screws onto the threaded nozzle of the sill cock. There are several methods of fastening these fittings to the hose. One method is by forcing the corrugated extension of the fitting back into the hose and putting a hose clamp around it. Another type of fitting has prongs which clamp down into the hose near the end.

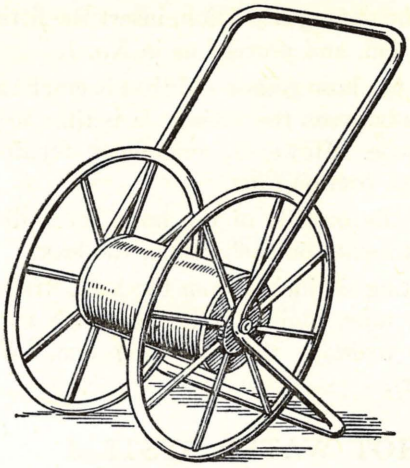


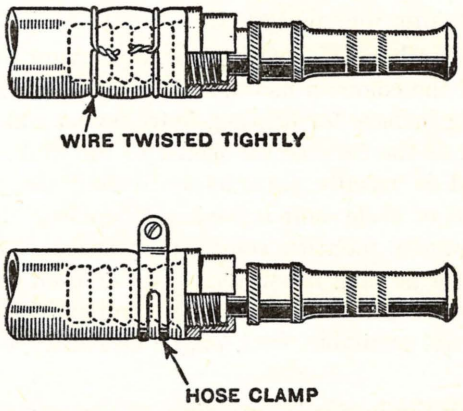
Fig. 398—Hose reel

JOB NO. 85

HOW TO REPAIR A GARDEN HOSE

A leaking hose is a nuisance that needs to be fixed immediately. If it is not rotted too badly, it is usually worth repairing. This can be done quite easily.

When a Hose Leaks at the Fitting: The usual place for a hose to leak is at a fitting. The hose stretches and becomes loose around the fitting. When this happens, there are two methods of stopping the leak.



Figs. 399(*a*) and 399(*b*)—Repairing a leaky hose fitting

1. Bind the hose tightly around the part of the fitting covered by the end of the hose. Use either a patented hose clamp or a piece of wire. Twist the wire tightly with a pair of pliers.
2. If the end of the hose is rotted or split, it will be necessary to remove the fitting. Then cut

off the damaged portion, insert the fitting in the new end, and proceed as in No. 1.

When the hose gets so old that it cracks and leaks at places between the fittings, it is time to purchase a new hose. However, emergency repairs can be made with friction tape.

1. Dry the outside of the hose, for a distance of eight inches on each side of the leak.
2. Starting six inches from the leak, wrap the hose with tape, making sure that each turn of the tape overlaps the preceding one. Wrap two layers.

THE HOT WATER SYSTEM

One of the things that make life easier for the housewife is a handy source of hot water. Methods of heating vary from the kitchen range teakettle to the modern electric heater which provides an ever-ready source of hot water. Whatever system is used, it should be used correctly in order to get the best results. With this in mind, some of the common methods are discussed.

The range boiler, or hot-water tank, is a fixture found in some form or other in the average home having a water-supply system. The hot-water tank is usually made of galvanized iron in the form of a cylinder, and holds from thirty to two hundred gallons, depending on the amount of hot water needed. More expensive tanks made of copper will last much longer than tanks made of galvanized iron because they do not rust.

The methods of heating the water very greatly. One of the common methods in homes using a coal-burning furnace for heating, is to have a coil in the firebox of the furnace connected to the tank. This method is usually satisfactory during the winter months, or while there is fire in the furnace. During the summer months, some other means must be found for heating the water. This is often done by means of a gas coil heater. In communities where gas is not available, coal, oil, or electricity may be used.

When the heater is operating, as the water in the coils is heated, it rises up through the coils of the heater to the top of the tank, and more cold water is drawn into the coils from the bottom of the tank. The amount of hot water in the tank may be felt by placing the hand on the outside of the tank. The tank always becomes warm at the top first. The water drawn from the hot water faucet comes from the top of the tank where the water is hottest.

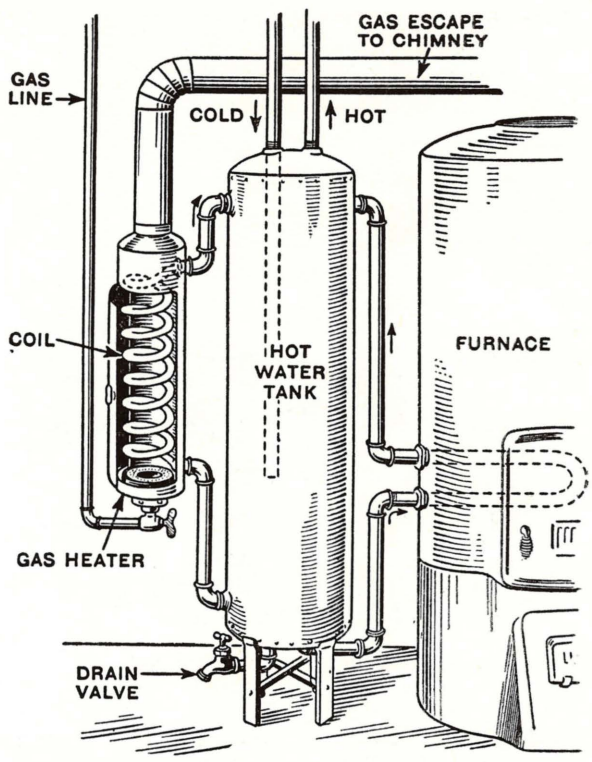


Fig. 400—A common water heating arrangement in the average home

The pipe bringing the water from the water main to the tank extends about two thirds of the way down into the tank so that it does not cool the water already heated. Cold water comes into the tank as fast as the warm water is drawn out. Water is circulating continually through the heater as long as the heater is hot.

Extreme caution should be used, that the heater is not left turned on too long. The water will turn to steam and build up enough pressure to do serious damage. It may damage or burst the water meter, or even the tank itself. This is the reason for the gasket union described previously on page 128. Even though the gasket union does function the way it should, steam escapes and fills the house, often doing considerable damage.

There are numerous devices which can be attached to the coil heater to make it more convenient. One is a thermostat which is attached to the tank to turn on the heater automatically when the water gets below a certain temperature. Another is a push-button device permitting the heater to be turned on from the kitchen or bath room. In either case, where gas is used, a pilot light is necessary. A pilot light is a tiny gas flame which burns continually, and which lights the gas flame when it is turned on.

Unless there is a gas escape pipe connected with the chimney, there is danger of an explosion in case the pilot light goes out.

There are other more convenient, and more expensive types of water heaters. The heat may be furnished by oil, gas, or electricity. These heaters are automatic, and require no attention. An ever-ready source of hot water is available, day or night.

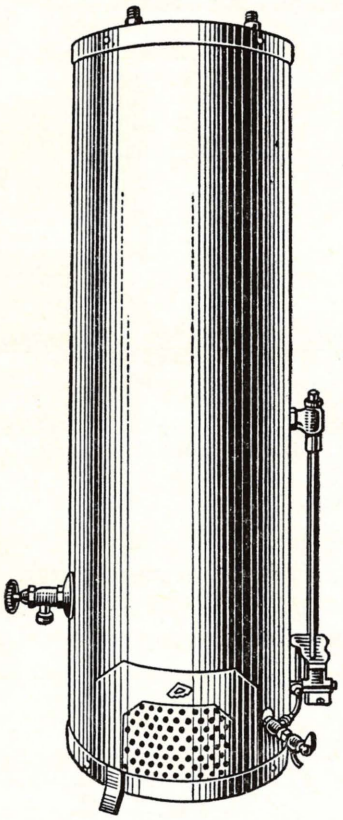


Fig. 401—Automatic hot water heater

Insulation for Pipes and Tank

Automatic water heaters must be well insulated. Otherwise the cost of running them would be too high, due to the loss of heat by radiation. The water would not stay warm all day long and more fuel would have to be used. The ordinary hot-water tank should be insulated for the same reason. Insulation jackets made of asbestos or magnesite can be purchased and installed by the home owner, or by the plumber or heating engineer. The amount saved in heat will soon pay for the cost of insulating.

Water pipes are often insulated. There is considerable loss of heat through water pipes, especially if the outlet is a long distance from the hot-water tank. Cold-water pipes sweat during hot weather, and water drips from them onto the basement floor. This is one cause of damp basements. If they are insulated to prevent the warm summer air from striking them, they will not sweat, and the water will remain cold.

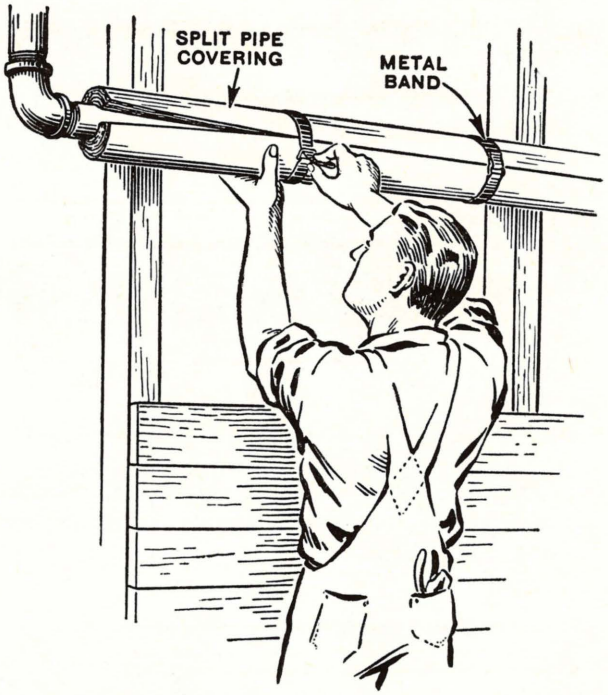


Fig. 402—Pipes may be insulated by the home repairman

JOB NO. 86

HOW TO INSULATE WATER PIPE

When a hot-water faucet is a long distance from the hot-water tank, the water cools in the pipe. Much water is wasted because the cooled water must be drawn off before hot water may be drawn from the faucet. This can be prevented by insulating the pipe. Also, cold-water pipes may be insulated to prevent them from sweating during hot weather. Here are a few suggestions:

Method No. 1. Using standard pipe covering.

Equipment Necessary:

Pipe covering should be purchased to fit the pipe to be insulated. Asbestos cement should be purchased for the joints. Some kind of cloth, usually white muslin, should be used for wrapping the joints. Metal bands for fastening will come with the insulation. Directions for using may come with the insulation. Otherwise, follow this plan.

1. Cut a length of insulation to fit between the pipe fittings. It can be cut with an old hand saw.
2. Place insulation around the pipe by opening the slit in insulation.
3. Fasten the insulation in place with the metal bands.
4. Sew cloth flap in place with needle and wrapping cord.
5. Mix asbestos cement into a paste that can be worked with a putty knife.

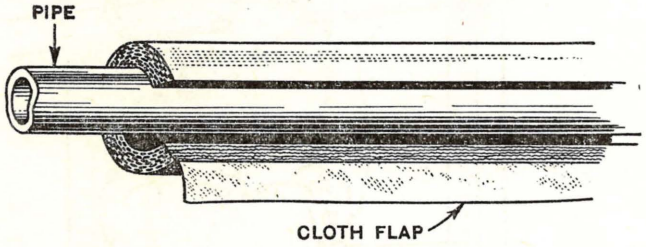


Fig. 403—Pipe covering is split to make installation easy

6. Cover the joints, one at a time with the asbestos cement, making them the same size as the rest of the insulation.

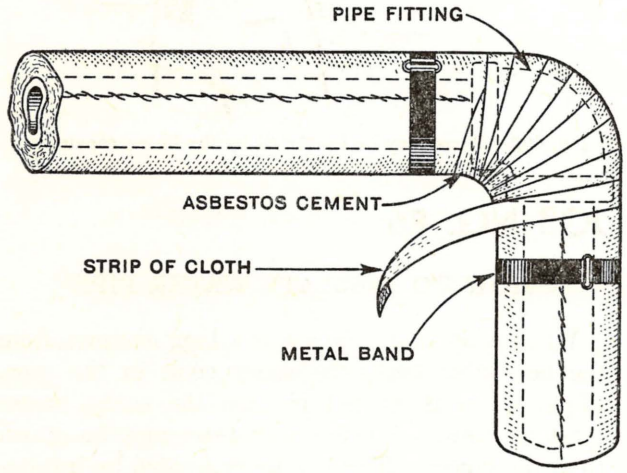


Fig. 404—The fittings are plastered with asbestos cement and allowed to dry

7. Wrap the cemented joint with strips of cloth to hold the cement in place. The ends should be cemented with the thinned asbestos cement.
8. Allow to dry.

Method No. 2.

Equipment Necessary:

A roll of asbestos sheeting may be purchased at the hardware store. Fine brass or copper wire should be used to hold the insulation in place. Excellent wire may be obtained by unraveling an old piece of bronze screen. Iron wire should not be used because it rusts.

Suggestions for Doing the Job:

1. Cut asbestos sheeting into strips two or three inches wide.
2. Wet the asbestos strips with water to make it easier to handle without tearing.
3. Wrap the strips of wet asbestos around pipe in spiral fashion.
4. Tie insulation in place with fine copper or brass wire.

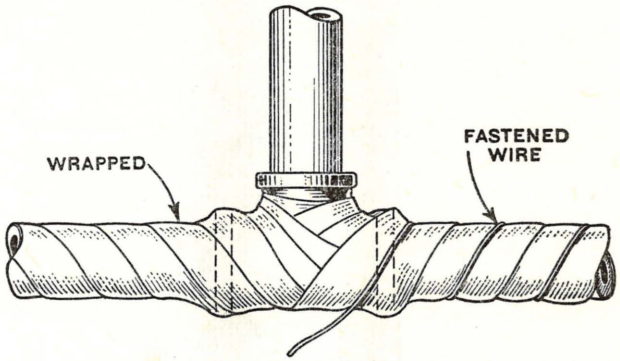


Fig. 405—Pipes may be wrapped with asbestos sheeting and tied with wire

Method No. 3.

Wrapping pipes with ordinary paper, or cloth, will serve the purpose of an insulator. It is not as efficient, however, as asbestos sheeting or regular pipe covering. Several layers should be used. It should also be painted to reduce the fire hazard.

JOB NO. 87

HOW TO PLUG A LEAK IN A HOT WATER TANK

Hot water tanks are made of galvanized iron. The zinc coating prevents rust. If the zinc coating is broken, rust will soon eat a hole through the tank. When the first hole occurs, it is a good indication that a new tank will be needed soon. However, it is sometimes necessary to make emergency repairs on an old tank. Many ingenious methods have been invented. The simplest, and quickest, is to drive a dry, sharpened toothpick or match stick into the hole. When the wood becomes wet, it expands, filling the hole. This repair will not last very long. The toggle bolt is a much more satisfactory repair.

The Toggle Bolt Method:

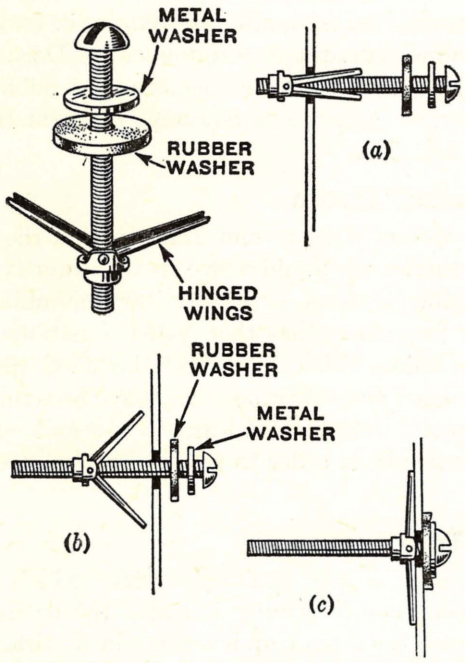
Materials Necessary:

Get a toggle bolt, a rubber washer and an iron

washer from the hardware store. The rubber washer from a compression faucet may be used. It must fit tightly on the toggle bolt.

Here Is a Good plan for Doing the Job:

1. Shut off the water on the supply pipe at the top of the tank.
2. Open the drain valve at the bottom of the tank and drain out the water. The water will drain out faster if the hot water faucet is opened.
3. Drill or punch the hole large enough to insert the toggle bolt with the wings folded.
4. Prepare toggle bolt so that rubber washer will be next to the tank.
5. Insert the toggle bolt.



Figs. 406–407(*a*), (*b*), (*c*)—The wings of the toggle bolt spread after being inserted in the hole

6. Tighten the screw by hand and with a screwdriver. Be careful not to tighten the screw so tight that the wings of the toggle bolt will break through the wall of the tank.
7. Close the drain valve, open the shut-off valve on the supply pipe, and refill the tank. If it still leaks, tighten the screw.

The Patented Plug Method:

Many different kinds of plugs for repairing leaks in hot water tanks may be purchased at the hardware store. It is impossible to give directions for installing all of them. Complete instructions are usually furnished with each plug.

Dirty Hot Water

Often water coming from the hot water faucet is dirty or rusty. This condition is sometimes caused by dirt accumulating in the hot water tank, and can often be remedied by the household mechanic.

1. Keep all hot water faucets in the house turned off for about one hour. This allows the dirt to settle to the bottom of the tank.
2. Open the drain valve at the bottom of the hot water tank. This should drain off the dirt which has settled to the bottom.
3. Close the valve and repeat the process in about one month.

WASTE DISPOSAL

Every home has its problem of waste disposal. Modern cities have an elaborate sewerage system which makes the problem very simple for the home owner. The underground sewerage system carries away all of the liquid and semi-liquid waste matter. The garbage collector gathers all solid materials such as kitchen scraps, and hauls them to a garbage disposal plant where they are burned or made into fertilizer. Even rubbish, such as tin cans and ashes, is hauled away to city dumps where it is used to fill in low swamp lands, making desirable building locations.

Smaller communities often have difficulty in providing such services, and the disposition of waste must be solved by each individual family. Fresh garbage is usually in demand by farmers for feeding pigs and chickens. Rubbish can be used to good advantage to fill gullies, stopping erosion. The disposal of sewage, is not such a simple problem. Running water in relatively large quantities is necessary to operate a sewerage system, therefore both water and a sewer are necessary.

Sewers and Sewage

Sewage is liquid waste. Any waste that can be dissolved in water can be disposed of through a system of drains and pipes. The large underground drain which carries the sewage away from a building is called a sewer. The system of underground drains which carries away the waste from a city is called the sewerage system. Smaller communities empty their sewage into rivers and streams. Strict sanitary laws are now requiring cities to construct sewage disposal plants to prevent the pollution of streams.

The Outdoor Toilet

The outdoor toilet may be necessary where sewage and water supply systems are not available. In this event, the toilet should be located far enough away from the source of water supply that the seepage will not make the drinking water unsafe to use. Chemicals should be used frequently to destroy the odor and waste matter. By all means, the toilet should be well ventilated and well covered to keep out flies, rats and chickens. Regular chemical toilets may be purchased which are very satisfactory if cared for according to directions. Complete directions for the construction of a sanitary outdoor toilet may be obtained from the Superintendent of Documents, Washington, D. C. for five cents. Ask for Farm Plumbing (Farmers' Bulletin 1426) A 1.9:1460.

The Septic Tank

Where no outlet for a sewer is available, some means for taking care of sewage must be provided. The septic tank is commonly regarded as the most satisfactory. In installing a septic-tank system, an underground drain of cast iron sewer pipe should be laid from the house to the tank. The slope should be such that the sewage will flow away from the house by gravity. The drain should be deep enough underground that it will not freeze during the winter. Also, the drain must be large enough so that it will easily carry all of the sewage. Only enough water should be used to carry the sewage through the drains and into the tank.

The septic tank itself may be constructed entirely of concrete. It can be located any desired distance from the house, since there is no odor from it. In this tank the sewage decomposes and becomes liquid. Then it flows away through the drain. Solid matter settles to the bottom of the tank. Cloth, or pieces of hard paper should never be thrown into the sewer because they do not dissolve.

The liquid which flows through the septic tank must be drained off by means of regular sewer tile, to a place where it is to be absorbed into the earth. At that point, branches of field tile laid with open joints covered with tar paper to prevent filling with earth, take care of the absorption. It is often necessary to lay a number of lines of field tile, depending on the kind of soil and the amount of liquid to be absorbed. (See Fig. 409.)

Septic tanks may be built of concrete on the job or bought ready built of steel and concrete in sizes suitable for a small family, or large enough for a small hotel or community. The installation of a septic tank is a big task, but the added protection from unsanitary methods makes it well worth while. More complete information on the septic tank may be obtained from the Superintendent of Documents, Washington, D. C. for five cents. The publication is known as Sewage and Sewerage of Farm Homes, No. A 1.9:1227.

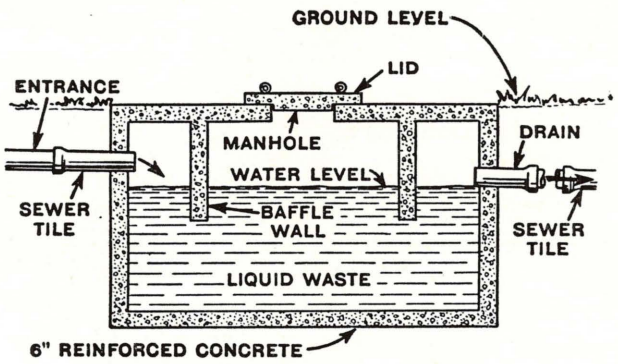


Fig. 408—Section view of a septic tank

The Sanitary System

The system of pipes and drains within the house which carries the liquid waste to the sewer is called the sanitary system, or the sanitary plumbing. It is very important that this system functions properly. Drains which have been installed properly will function properly unless they have been misused. The home owner should learn to use and care for them properly in order to get the best service from them.

Drain Traps

The part of the sanitary system which needs attention most frequently is called the drain trap. In general, the drain trap is a curve in the drain pipe which holds a water seal all of the time. Foul gases collect in sewers and drains. The water seal prevents these obnoxious gases from entering the house through the sink drain and other openings. All drains in the house have traps which hold a water seal, so that gases cannot enter the house. Also, each drain has a trap especially designed to meet best the needs of that fixture. The diagrams, Figs. 410 to 416, illustrate some of the types found in the home.

The Care of Drains

The water seal in the drain trap which prevents foul gases from entering the house must be kept there at all times. Traps which are used regularly usually keep this water seal. If a trap has not been used for a long time the water may evaporate, and

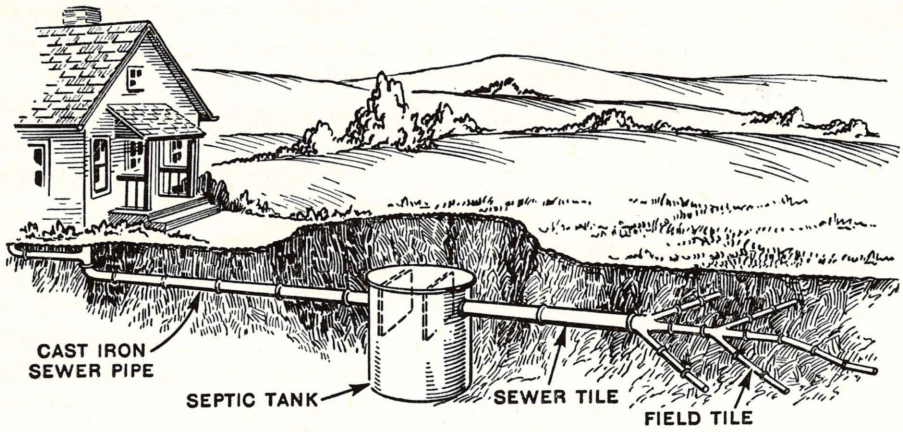


Fig. 409—The drainage system for a septic tank

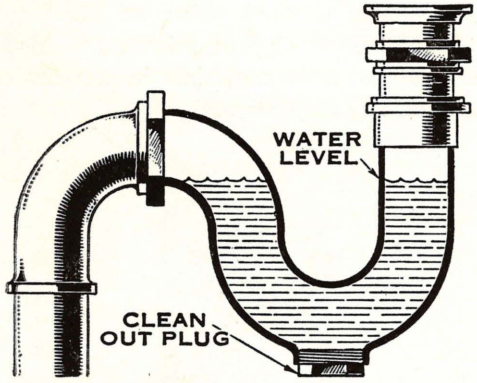


Fig. 410—Floor type trap

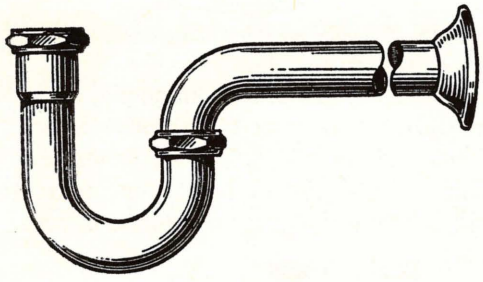


Fig. 411—Wall type trap

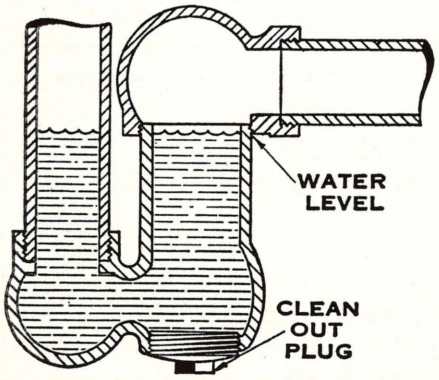


Fig. 412—The type of trap usually found under the kitchen sink or the laundry tubs

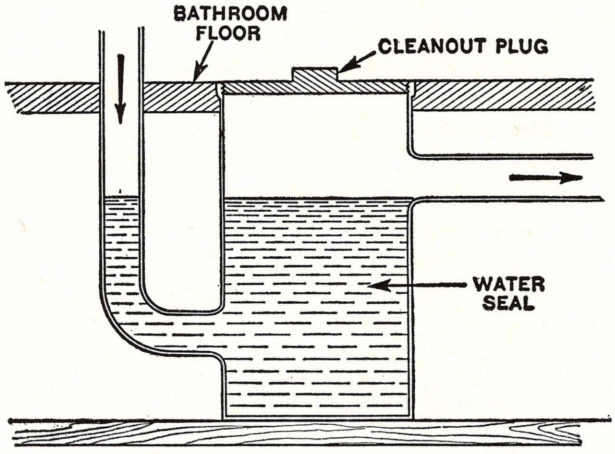


Fig. 413—The drum trap is found in the bathroom floor near the bath tub. The cleanout plug is all that can be seen

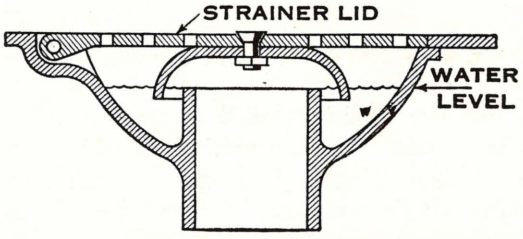


Fig. 414—The bell trap is found in the basement floor

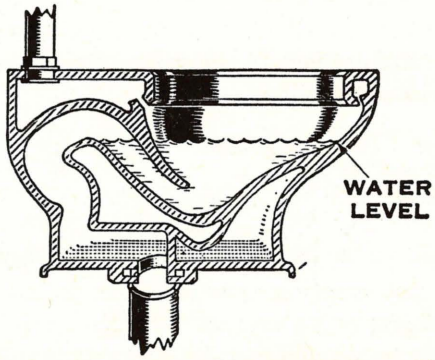


Fig. 415—The toilet bowl is constructed so that it is a trap in itself

then, the seal is gone. This is especially true of the trap in the basement floor. Also this trap is clogged more frequently than any other because the

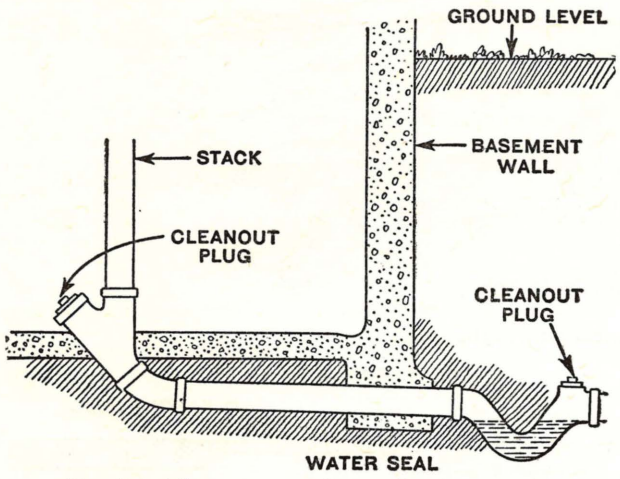


Fig. 416—The sewer trap is usually placed under ground outside of the house

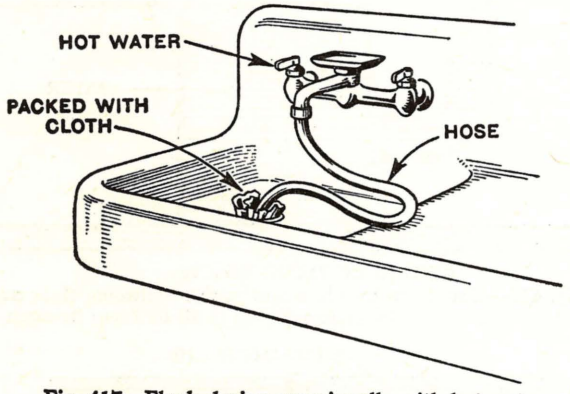


Fig. 417—Flush drains occasionally with hot water

dirt from the floor is washed or swept into it. If this floor drain is seldom used, it should be closed with a wooden plug so that the sewer gas is sealed in. Then it does not need filling every few days, and dirt does not get into the drain.

When a drain trap becomes clogged, the trouble is so frequently at the trap that it should be checked first. Another place to check the pipe is at an el or in a horizontal section.

Here Are a Few Suggestions to Follow:

1. Use plenty of water to wash away the waste. When dirty water stands in a pipe the dirt settles to the bottom, and some of it stays there.
2. Do not empty grease into the drains. When cold greasy water goes through a pipe, grease sticks to the cold metal. It does not take many coats of grease to cut down the flow of water through a pipe. This greasy surface also forms a sticky coating which collects bits of dirt, hair and thread.
3. Do not use ordinary lye to clean drain pipes. Lye combines with the grease to form soap which hardens and cannot be removed without removing the trap.
4. Never empty coffee grounds or any form of dirt or grit into the drains. They become embedded in the grease and are very difficult to remove.
5. Flush out the drains occasionally with hot water to remove grease. This can be done by fastening a hose to the hot-water faucet and inserting the other end in the drain. It may be necessary to pack this end with cloth and make it water tight. Turn the hot water on full force and let it run for two or three minutes. This should remove any loose materials in the drain, and melt some of the grease.

Fig. 418—Use commercial drain cleaner occasionally

6. It is a good idea to use commercial drain cleaner frequently. Be sure to use according to directions, and use plenty of hot water afterwards. This compound will help remove grease, and will eat materials such as hair and cloth.

Cleaning Drain Traps

Sometimes, in spite of good care, drain traps become clogged permanently. Regardless of the cause, when a drain trap is clogged, it must be cleared. There are a few home remedies which should be tried before opening the trap with a wrench.

1. Try flushing with hot water.
2. Try commercial drain cleaner, according to the directions printed on the container. Drain cleaner is a strong chemical, and care should be taken that it does not get on the skin or clothing, or on enamel surfaces.
3. Use the plunger, or plumber's friend. This suction cup, when worked up and down may loosen the obstruction.

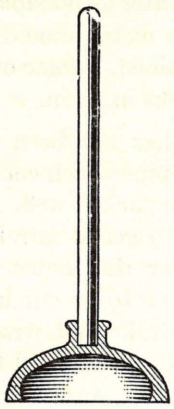


Fig. 419—The plumber's friend is a bowl-shaped rubber disc which acts like a pump to force a passageway through a drain

4. Use a piece of twisted wire or a plumber's snake to remove any cloth, hair or other obstruction which may be lodged in the drain.

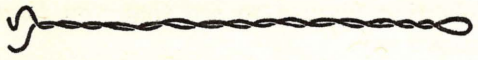


Fig. 420—A twisted wire can be used to remove obstructions in a drain

5. As a last resort, remove drain plug at the bottom of the trap. Be sure to have a pan setting underneath to catch the water. Be careful not to get any of the dirty liquid containing the lye on the hands or clothing. A good strong monkey wrench will be needed to loosen the drain plug. If the plug does not come out easily, it may be loosened by tapping it with a hammer or heating it with a candle. When the plug has been removed, it is often possible to dig out the obstruction with a sharp instrument.

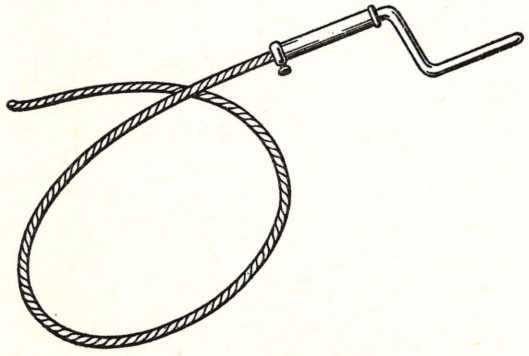


Fig. 421—The plumber's snake

6. If all of the above suggestions have been tried without results, it is best to call a plumber. It may be necessary to have the drain replaced. The home owner should not attempt to do this.
7. Never attempt to drive sharp instruments into the drain to clean it out.

JOB NO. 88

HOW TO CLEAN A DRAIN TRAP

When a drain trap becomes clogged, the entire household is put to great inconvenience. Such a time provides a good opportunity for the student to make himself useful at home.

Since there is no way of telling just what is wrong without seeing the job, the only plan that can be given is for the student to follow the suggestions given under the heading of *Cleaning Drain Traps.*

The student may desire to write a report on the job, telling just what he did, and the results. This report may be signed by a parent, and given to the shop teacher for school credit.

CLOSING A HOUSE FOR THE WINTER

Whenever it is necessary to close a house for the winter, the plumbing should be taken care of so that it will not freeze. This more often happens in colder climates. It is really a simple matter to prevent freezing, thus avoiding expensive repairs.

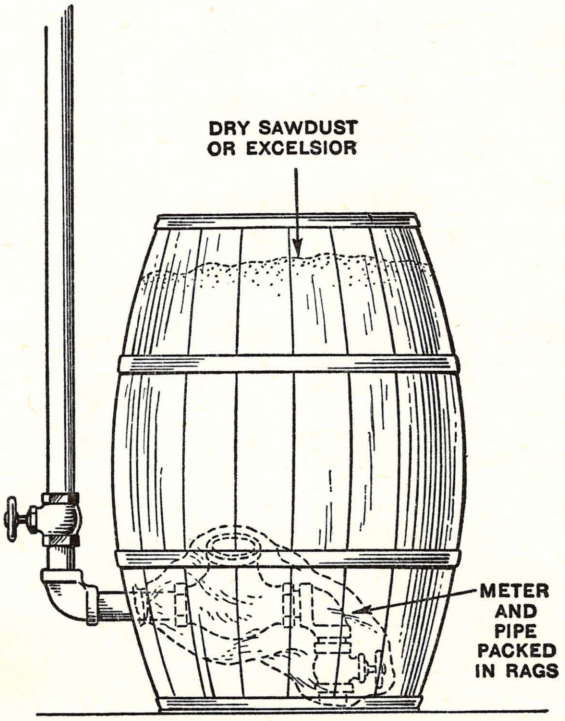


Fig. 422—The water meter should be packed when closing the house for the winter

Water which has frozen and burst the pipes will thaw out when the weather becomes milder, and may flood the house.

EQUIPMENT NECESSARY

The only tools necessary are a monkey wrench and a pair of pliers. The only materials necessary are a piece of cloth, kerosene for filling the traps, and packing materials for the water meter.

It is well to follow an orderly plan in doing this job as there are so many little things to do that may easily be overlooked.

1. Turn off the water below the water meter.
2. Open the stop and drain cocks, above and below the water meter. This allows the water from the pipes and the water meter to run out.
3. Open the drain cock at the bottom of the hot water tank.
4. Open all the faucets in the house, starting on the top floor. This releases most of the water held in the pipes.
5. Flush the toilet. This empties the tank, which will not refill because the water is shut off. If any water remains in the bottom of the tank it should be taken up with a rag.
6. Blow through each faucet to be sure that no water remains in the pipes.
7. Get as much water as possible out of the meter. If possible the meter should be taken off and thoroughly drained. Some of the newer meters have drain cocks in them.
8. If the meter has not been drained both the meter and the pipe which comes from the water main should be packed well. The best method of packing is to get a barrel or packing crate and set it over the meter and supply pipe. A hole will have to be cut in one side for the other pipe. Drain and wrap the meter first in woolen rags, and then fill the barrel or crate with dry sawdust, excelsior, or rags packed well to keep out the cold.
9. Remove the water from each drain trap by forcing it out with a plunger or siphoning it out if the plug at the bottom of the trap cannot be removed.
10. Refill each drain trap with an anti-freeze solution, preferably kerosene. Be sure to check the following fixtures to see that you have not missed any.

(*a*) bath tub
(*b*) wash stand
(*c*) toilet bowl
(*d*) kitchen sink
(*e*) laundry tubs
(*f*) hot water tank

The Care of Doors

Chapter 6

DOORS play a very important part in the every day use of the modern home. From the time when people began to use doors until the present day, they have been learning ways to make them more useful. The architect of today takes advantage of the experiences of the past in planning the doors of the modern home. For instance, doors must be arranged so that convenient passage is provided from one room to another. They must be built strong enough to keep their shape and stand up under every day usage. Outside doors must be designed to withstand the weather and to conform with the architectural design of the building. Doors also play an important part in the heating and ventilating of the modern home.

Our study of doors will concern itself with the construction of the door itself, the frame in which it is fitted, the hinges on which it swings, and the lock and latch which holds it firmly closed. There are many kinds of doors and hardware used in the modern home, depending on the purpose each is intended to serve. Those found in the average home will be discussed here.

Door Construction

The design and construction of doors has changed from time to time over the years, but in the main, the door today is much the same as the doors used in colonial days. The panel door has a strong framework which holds thin panels in place. In Fig. 428 the main parts of a panel door are named. Note that the heavy vertical pieces are called stiles and the horizontal pieces are called rails. The panels are made of thin wood which fit loosely into grooves cut into the edges of the rails and stiles. The rails are fastened rigidly to the stiles with mortise-and-tenon joints, or by hardwood dowels set in waterproof glue. Thus, panel doors are strong and rigid in construction, while at the same

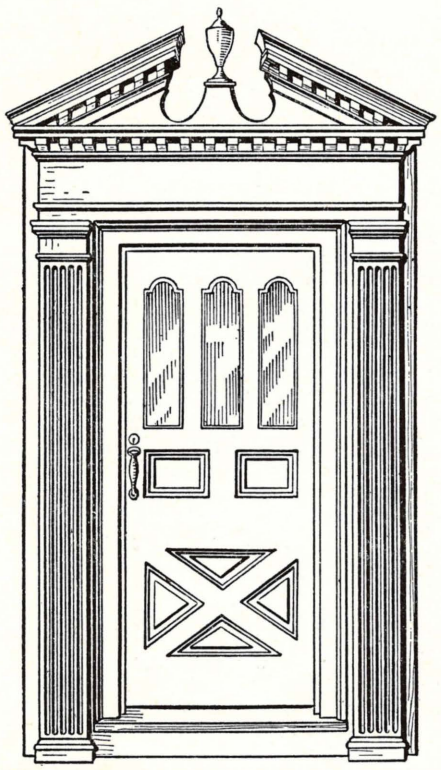


Fig. 423—Exterior panel door having both wood and glass panels

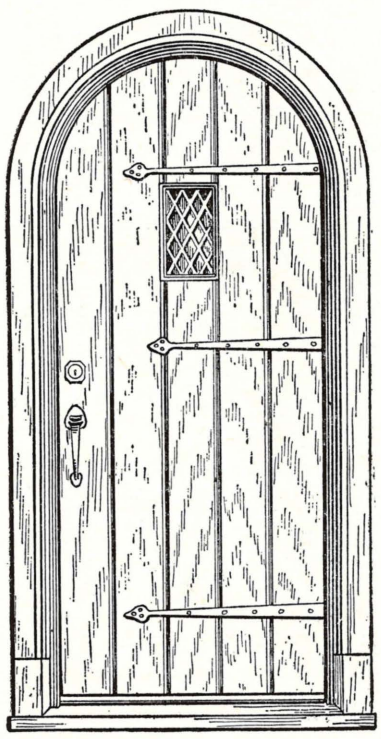


Fig. 424—Exterior slab door having the appearance of heavy planking

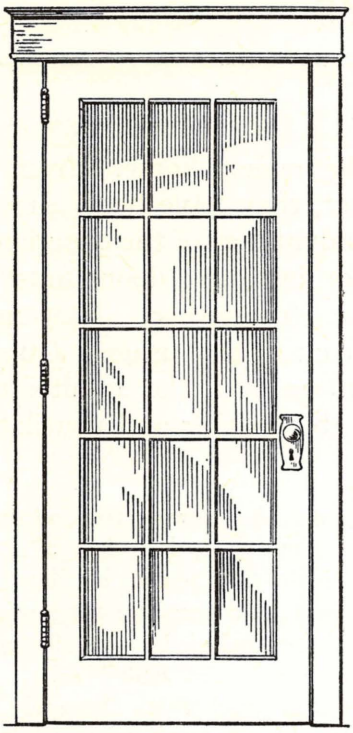


Fig. 425—The French door is really a panel door with glass panels

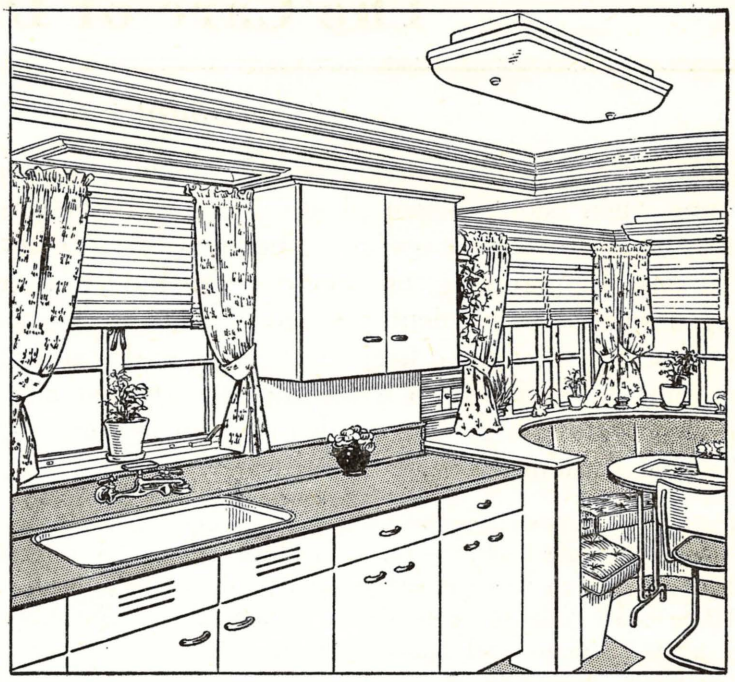


Fig. 427—The flush type cabinet door is popular for modern kitchens

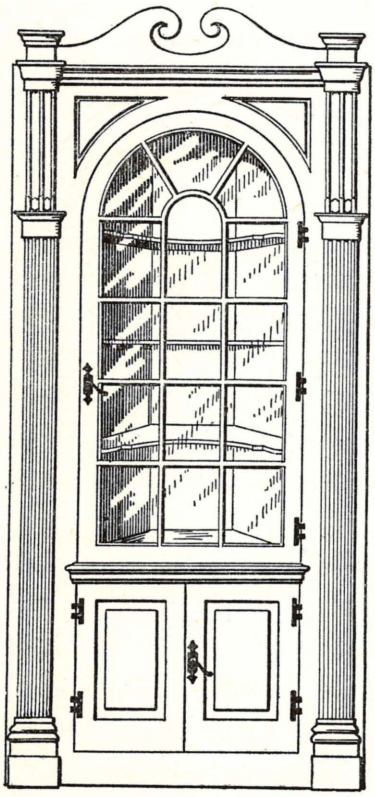


Fig. 426—The glazed cabinet door is lighter in construction than the French door. Cabinet doors are also paneled

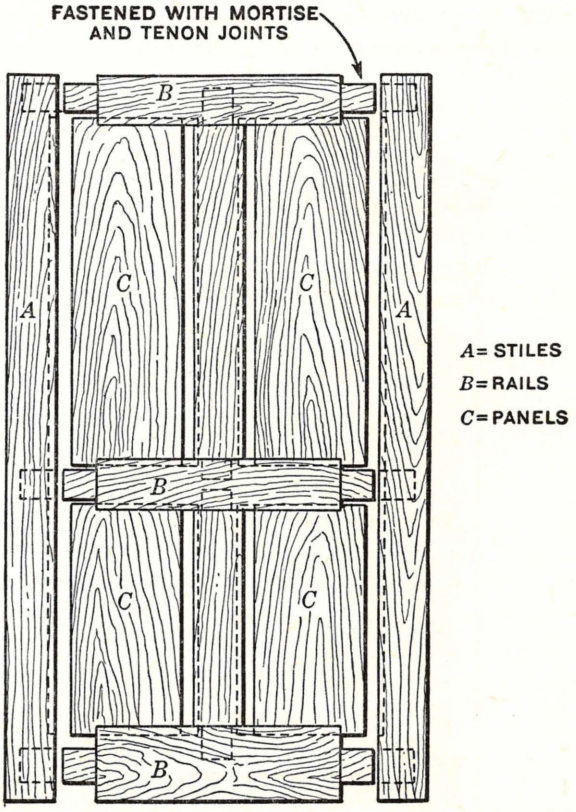


Fig. 428—The construction of the panel door

time the loose panels allow for considerable expansion and contraction due to changes in heat and moisture.

A real slab door is made of solid planks fastened together. This type of construction is very heavy, and is rarely found in modern homes. The door usually found is made of plywood glued to a strong, heavy frame. It is much lighter than the real slab door and will hold its shape much better. The planking effect is often obtained by cutting grooves in the plywood. (See Fig. 424.)

French doors, and glass paneled cabinet doors are made in a manner very similar to the regular panel door except that glass is used as panels, and is inserted after the door is assembled. (See Fig. 425.)

Cupboard doors made of plywood or laminated panels are called flush doors. They are very much in demand for the modern kitchen because they are very easy to keep clean. (See Fig. 427.)

The Size of Doors

Doors are manufactured in standard stock sizes, but they may be ordered specially built to fit any size or shape opening. A door three feet wide by seven feet high is standard for exterior front entrance doors. A door two feet eight inches by six feet eight inches is commonly used for the rear entrance. Inside doors are usually smaller than outside doors, and may be secured in a very large number of stock sizes, but the two feet six inches by six feet eight inches door is very commonly used. Cupboard and cabinet doors are manufactured in a very large number of stock sizes. In planning construction much money can be saved by consulting a builders catalog and using stock sizes.

Door Openings

The door opening, or doorway, is a frame into which the door is fitted. The architect specifies a door of a certain size and shape when he designs the house. The carpenter knows just how much space is necessary to frame a door of that size. After the rough carpentry is done and the finish is installed, the opening is very close to the size specified in the plans. Only a small amount of fitting is necessary when the door is hung. Circle head and irregular shaped doors are usually bought with frames completely fitted at the mill. In this case fitting on the job is not necessary.

The opening for a door is usually framed with two-inch stock. For inside doors the jamb is a plain piece of finished stock nailed to the frame. For outside doors, the jamb is rabbeted on both edges

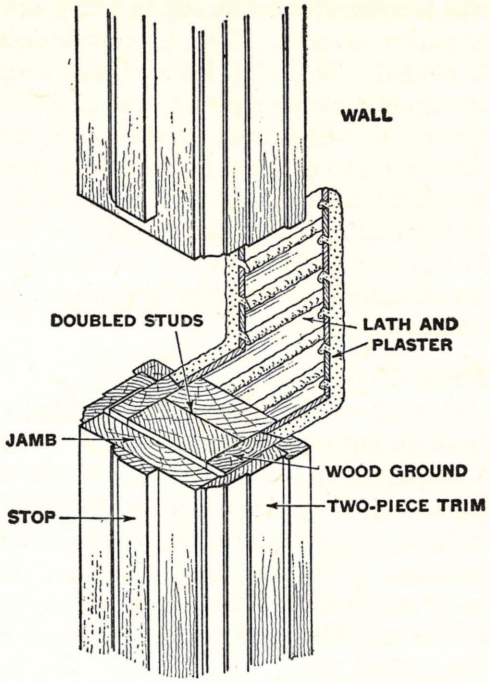


Fig. 429—Section view of framework for an inside door

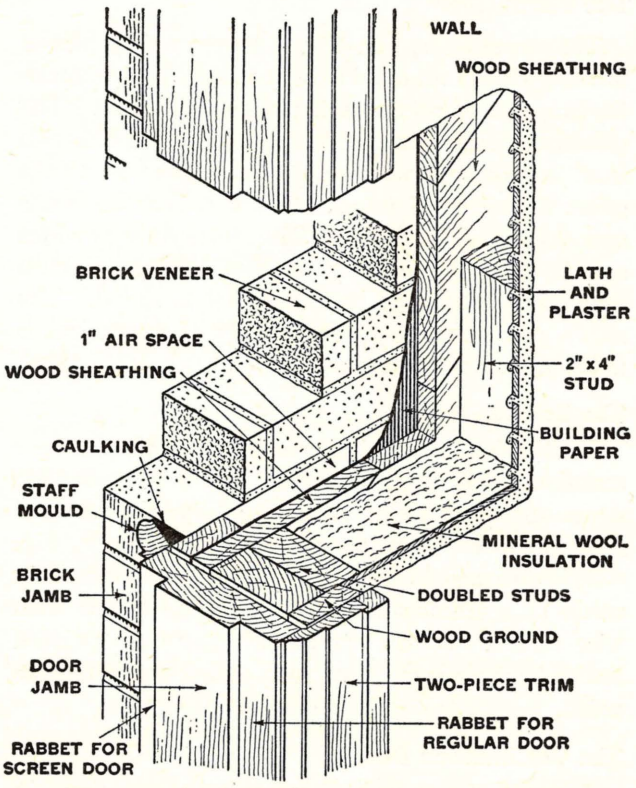


Fig. 430—Cut-away section view showing construction of wall and frame of an outside door

to permit hanging two doors, one to swing inwards, and the other outwards. Thus, for outside doors, no stop is needed. The stop for an inside door is a narrow strip of molding nailed to the jamb to stop the door and prevent it from swinging clear through the doorway. The casing is a piece of flat stock or molding nailed to the jamb and frame, and overlapping the plaster. In order to make a weather-tight joint, the space between the molding and brick-work on an outside doorway is filled with a calking compound.

The Threshold

The piece of stone, metal or wood placed at the bottom of an outside doorway to make a weather-tight fit is called a threshold. In modern homes, the threshold is frequently a piece of heavy brass formed in such a manner that it engages another piece of brass on the bottom of the door. In this manner it serves as an excellent weather-stripping to keep out cold air. A threshold is not ordinarily used for inside doors, except where the flooring material changes, as under a bathroom door, where a tile floor is used in the bathroom. The threshold then covers the joint between the wood flooring and the tile.

The Storm Door

The storm door, Fig. 431, is an extra door placed in the frame of an outside door to save fuel to make the house more comfortable during the winter. The glass in a single outside door becomes covered with frost during cold weather. This is because of the great difference of temperature between the inside and outside of the house. The storm door provides a dead-air space between the two doors so there is much less heat lost, therefore fuel is saved. The storm door may be made entirely of wood, but is usually paneled with glass.

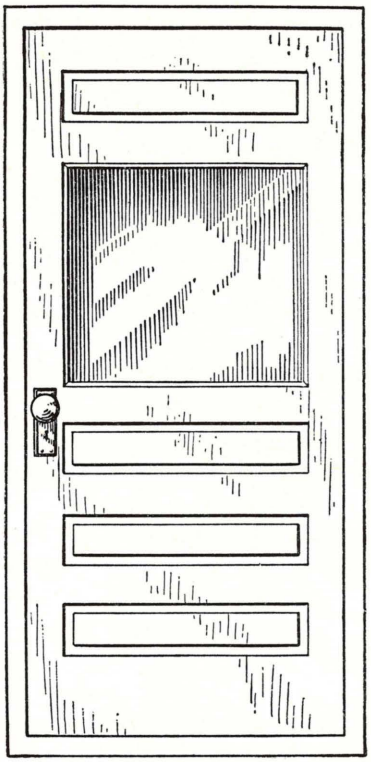


Fig. 431—The storm door

The Screen Door

Ventilation is very important during the summer months. It is often impossible to leave the outside doors open because of insects, and because an open door provides no privacy. The screen door, Fig. 432, is designed to solve this problem. It is usually made of a framework of wood, and covered with wire screen. Bronze screen is better than painted screen because it does not rust, and does not require paint.

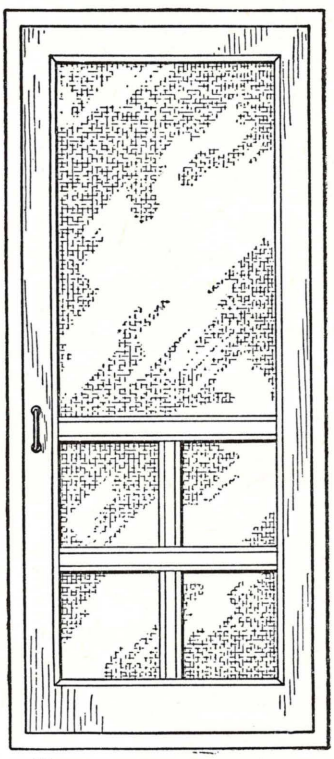


Fig. 432—The screen door

The Combination Door

Because of the task of removing storm doors in the spring and replacing them with screen doors, the combination door, Fig. 433, has been designed. The door itself is much the same as that of the

storm door except that it has two sets of panels, one of glass and the other of screen. The glazed panel may be removed and replaced by the screened panel. This saves the labor of removing the entire door and using two sets of hinges.

The Care of Doors

Doors require attention from time to time if they are to give satisfactory service. The care of doors means doing the things necessary to keep them operating properly. It is much easier to do this than to repair a door once it has ceased to function as it should.

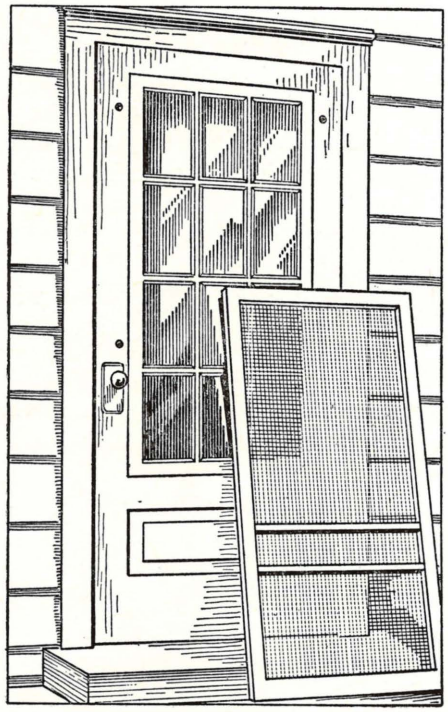


Fig. 433—The combination door

Use Doors Properly. A door cannot be expected to give good service very long if it is abused. Children swinging on doors, or loading them down with heavy coats or utensils will soon get them out of line. Door stops should be provided to prevent them from opening too far. Bumpers should be provided to keep them from slamming.

Keep Doors Sealed With Paint or Varnish. This is one of the most important things in the care of the door. The household mechanic can do this job. If a door is not sealed with paint or varnish, it absorbs moisture during damp weather and swells until it is too large for the opening. It then becomes necessary to plane the edge of the door. When the wood dries out again, the door may be too loose.

JOB NO. 89

HOW TO PAINT A DOOR

Get the Necessary Tools and Materials. See instructions on painting with inside paint, page 63.

Here Is a Plan Which Works Well for Painting a Door.

1. Remove the escutcheon plates from the door, but not the lock. It is easier to remove the escutcheon plates than it is to try to paint around them.
2. Cover the floor underneath the door with cloth or paper so as not to get paint on the floor.
3. Apply the priming coat of paint.
   (*a*) The door should be removed from the hinges and the top and bottom painted first. Be especially careful to get as much paint as possible on the end grain of the lock and hinge stiles.
   (*b*) Replace the door and paint both surfaces and the edges, being careful to work the paint into all cracks and joints. Here is an order which works very well.
      (1) Panels—center stile—rails—lock and hinge stiles.
4. Allow at least 24 hours to dry.
5. Fill nail holes, cracks and blemishes with putty.
6. Sand all surfaces smooth.
7. Apply one or two coats of flat paint, allowing at least 24 hours after each coat to dry. Don't forget the top and bottom.
8. Sand lightly with No. $\frac{1}{2}$ sandpaper.
9. Apply the enamel coat. Enamel is very difficult for the amateur to apply without the enamel sagging. Here is a suggestion which will enable the amateur to do a professional job. Remove the door from the hinges and lay it flat between two chairs. Apply enamel to the top side only. Allow this side to dry completely, usually 48 hours, before turning the door over and finishing the other side and the edges. While the door is removed, here is a chance to seal the wood underneath the hinges.

Hinges

A hinge may be defined as a pivot, joint, flexible material, or mechanical device on which a door or gate swings. Thus, even a piece of leather might be called a hinge. Hinges are usually made of brass to prevent rust, and are usually installed with brass

screws. There are two main classes of hinges, butt and surface.

Butt hinges are those set into the edge of the door so that only the working part of the hinge may be seen. Loose pin butt hinges are used on house doors. Notice that the pin is always on the inside of a room or of a house, since doors open toward the inside. The pins may be taken out and the door removed should the lock fail to work. The riveted-pin butt hinge is commonly used on cupboard doors which are kept locked.

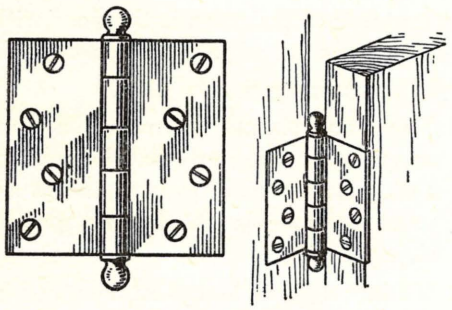


Fig. 434—The butt hinge

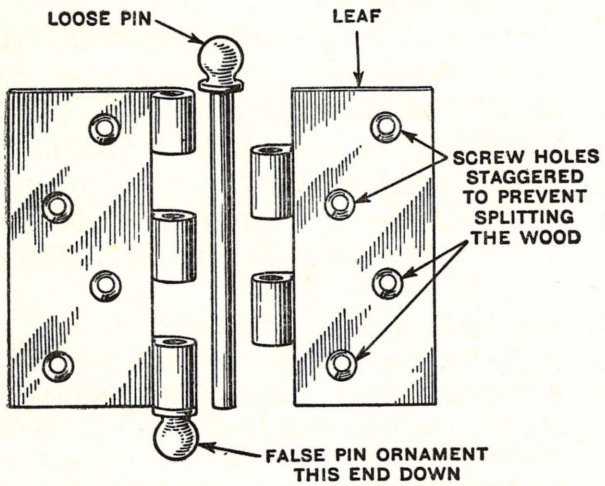


Fig. 435—The parts of the loose pin butt hinge

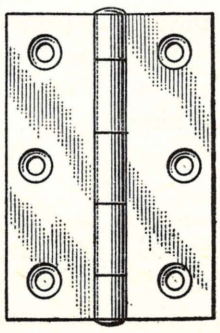


Fig. 436—Riveted pin butt hinge used on cabinets

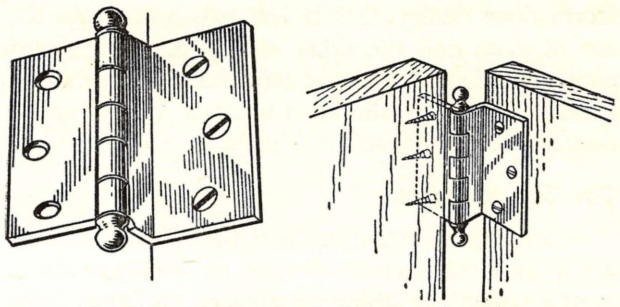
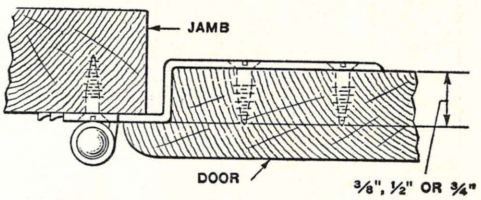


Fig. 437—Combination butt and surface hinge often used on screen doors

Surface hinges are installed on the outside surface of a door, gate or lid. They are made in a large variety of shapes and sizes ranging from the heavy strap-iron gate hinge to tiny ornamental hinges for small boxes and doors. They are also made in a wide variety of finishes since they are used on the outside of the door where they can be seen.



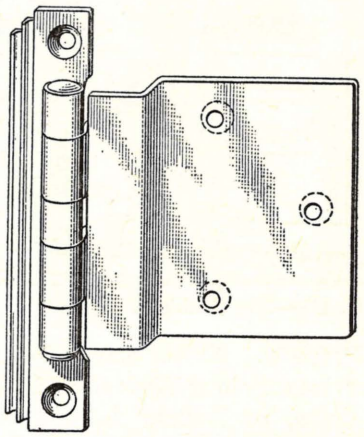


Fig. 438—Offset hinge for flush-type cabinet door

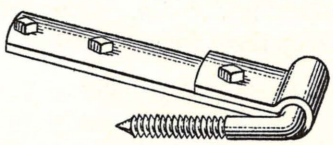


Fig. 439—Strap iron and screw gate hinge

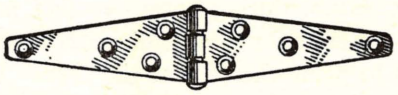


Fig. 440—Strap hinge for the heavy door

The Care of Hinges

A hinge will give good service for a long time if it is used properly. Here are a few rules which should be observed in order to get the best service from them.

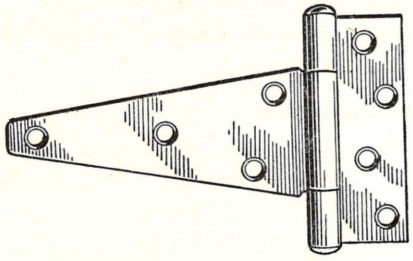


Fig. 441—T hinge for a heavy gate or door

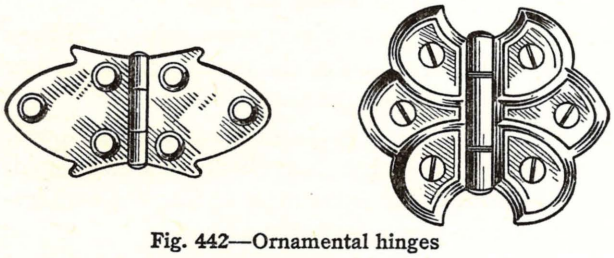


Fig. 442—Ornamental hinges

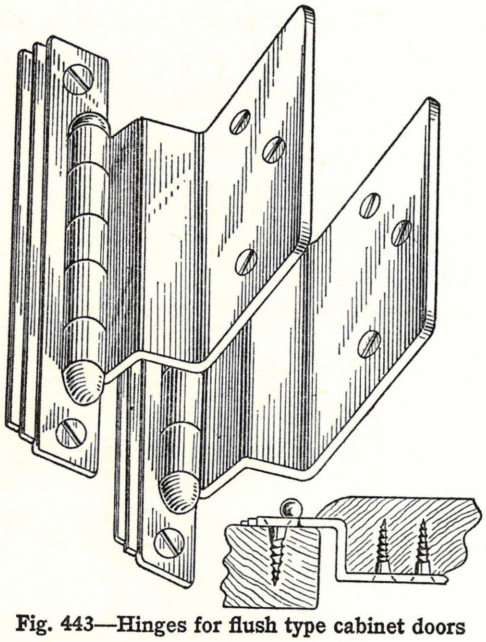


Fig. 443—Hinges for flush type cabinet doors

JOB NO. 90

HOW TO LUBRICATE HINGES

Nobody likes to hear hinges squeak. They squeak because they need lubrication. The home owner can remedy this easily by using materials found at home.

Tools Needed are: A screw driver and a hammer.

Materials Necessary are: Graphite, paraffin, or machine oil.

Here Are a Few Suggestions to Follow:

1. Loose-pin butt hinges.
   (*a*) Remove the pins. These may sometimes be removed with the fingers, but it will often be necessary to use the screw driver and the hammer to drive them out.
   (*b*) Rub the working surfaces with graphite. The lead in the ordinary soft lead pencil is a good grade of graphite.
   (*c*) Assemble.
2. Loose-pin butt hinges.
   (*a*) Remove the pins. (See Fig. 435.)
   (*b*) Rub the working surfaces with paraffin.
   (*c*) Assemble.
3. Riveted-pin butt hinges.
   (*a*) Remove hinges with screw driver.
   (*b*) Heat the working parts of hinges in melted paraffin.
   (*c*) Clean excess paraffin from the outside by wiping with a cloth.
   (*d*) Allow to cool.
   (*e*) Replace hinges.
4. All hinges.
   Everyone thinks of oil as a good lubricant. This is true, but there are certain objections to using it for hinges. It is apt to drip or run and stain the surrounding surfaces. Oil may be used to lubricate hinges, but it should be used very sparingly so as not to drip. Oil which works out through the joints in the hinges should be wiped off occasionally until the surplus has worked out of the inside.

JOB NO. 91

HOW TO INSTALL A SCREEN DOOR SPRING

When a screen door, or any door swings open too far, so that it strikes the casing or jamb, a great strain is put on the hinges. This will loosen them in a short time. The ordinary expansion door spring is easy to install, and is one of the simplest ways of solving this problem.

Necessary Materials:

A twist drill the proper size for the screw hook, a hand drill, and a pair of pliers are the only tools necessary. The expansion door spring complete

with two screw hooks may be purchased at the hardware store.

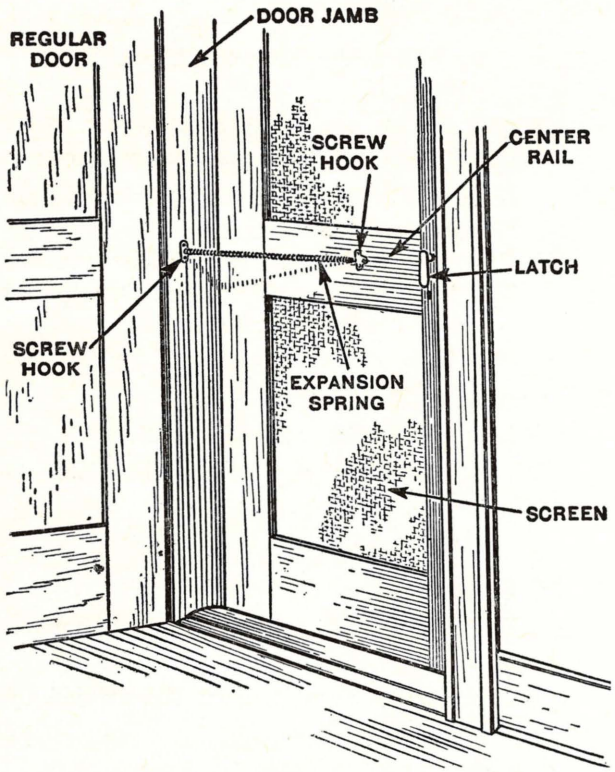


Fig. 444—The spring should close the door tightly

Here Is a Plan to Follow.

1. Drill the anchor hole for the screw hook in the door jamb opposite the center rail of the door. It may be at the top or bottom of the door, but the center is best. (See Anchor hole, page 8.)
2. Turn the screw hook into the hole with the pliers.
3. Fasten one end of the spring onto the hook.
4. Close the door and mark the location of the screw hook on the center rail by drawing the spring taut.
5. Drill the anchor hole for the other screw hook.
6. Turn the screw hook into the center rail, and fasten the spring.
7. Test the job by allowing the spring to close the door. If the spring is too tight, the screw hook will have to be moved back toward the hinge stile. If it is too loose, the screw hook will have to be moved toward the lock stile.

Various mechanical devices may be purchased to do the work of the expansion spring. Some are neater and more compact than others, but more difficult to install. Some will also prevent the door from slamming. Most of them may be installed by the household mechanic.

JOB NO. 92

HOW TO TIGHTEN LOOSE HINGES

Door hinges are apt to become loose due to abuse, neglect, or natural usage. When this happens, the door is thrown out of line and does not work well. The household mechanic can do this job of repair work.

Necessary Materials:

The tools and materials will vary with the job. Sometimes a screw driver will be enough. Other times, glue, a twist drill, hand drill, screws, screw driver, wooden pegs, plastic wood, and a hammer will be necessary.

Here Is a Plan for Doing the Job.

1. Tighten the screws with a screw driver. If they will not turn up tight, the threads in the anchor hole are probably stripped.
2. When the threads in the anchor hole are stripped, a larger and longer screw will sometimes hold. The head of the screw must fit into the countersunk hole in the leaf of the hinge.
3. The best method is to plug up the old hole and start a new one. This may be done as follows:
   (*a*) Whittle a wooden peg with a jack knife, large enough to fit tightly into the hole.

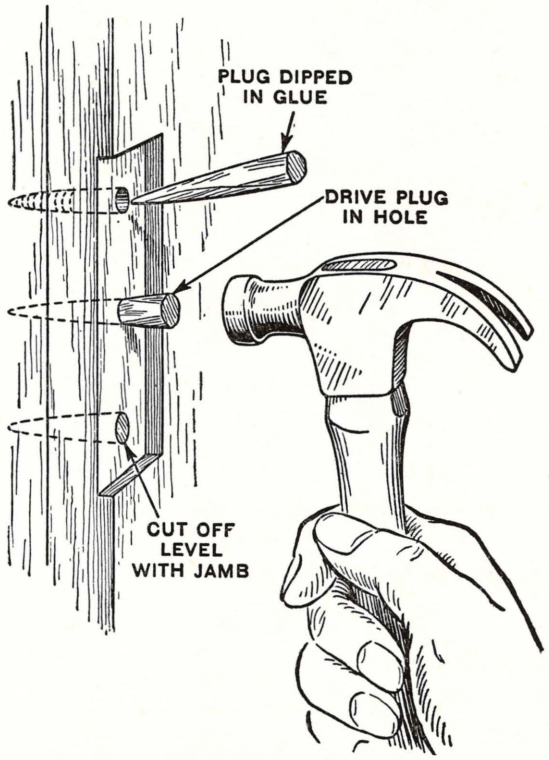


Fig. 445—Plug old screw holes with wooden pegs

(*b*) Dip this plug in glue and drive it into the hole with a hammer.
(*c*) Cut the top of the plug level with the surface of the wood with the saw or jack knife.
(*d*) Mark location of new screw holes, using hinge leaf as a pattern.
(*e*) Drill the new screw holes (anchor holes) with the twist drill and hand drill. (See Anchor holes, page 8.)
(*f*) Install hinge and test.

JOB NO. 93

HOW TO SHIM A HINGE

Sometimes it is necessary to raise one or both hinges in order to make a door fit properly. The easiest way to do this is to make cardboard shims to put under the leaf of the hinge.

Equipment Needed:

A screw driver, and scissors or a jack knife for cutting the cardboard.

Here Is a Plan for Doing the Job:

1. Remove the door. The bottom hinge should be loosened first. (See Fig. 467.)
2. Remove the leaf of the hinge to be shimmed.
3. Cut a piece of cardboard the same size as the flat part of the leaf of the hinge.
4. Place the shim under the hinge leaf and screw in place.
5. Replace the door and test. It is possible that another shim may be needed in addition to the one installed. Longer screws may be required.

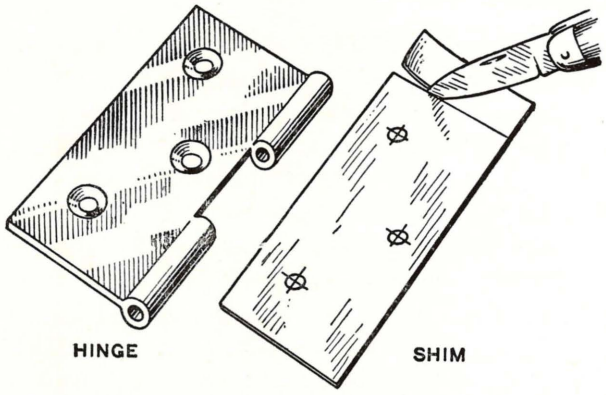


Fig. 446—A cardboard shim may be cut with the scissors or a jack knife

JOB NO. 94

INSTALLING DOOR BUMPERS

When a door swings open too far, it is not good for the door, the hinges, or the wall which it bumps into. The door knob may hit the plaster and punch a hole in it. The edge of the door may hit a low ceiling or molding and knock out some of the plaster. Or perhaps the door should be stopped to prevent hitting a piece of furniture. Regular floor or wall bumpers in wood or metal may be purchased at the hardware store and installed by the household mechanic.

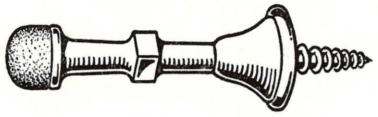


Fig. 447—A door bumper for the wall

Fig. 448—A door bumper for the floor

Tools Necessary:

A drill for drilling the anchor hole, and a screw driver or pair of pliers for fastening the bumper.

Here Is a Good Way to Do the Job.

1. Open the door as far as it is supposed to open without striking the wall or ceiling.
2. Mark the edge of the door on the floor with a pencil, or hold the stop in a position which will stop the door at the point desired. Mark the location of the holes to be drilled. Stops for the wall are usually installed on the baseboard.
3. Drill the anchor hole. (See Anchor hole, page 8.)
4. Screw the stop in place with screw driver or pliers.
5. Test the door to see that it is stopped at the point desired.

JOB NO. 95

HANG A SMALL DOOR WITH SURFACE HINGES

It often becomes necessary around the house to hang a small door with surface hinges. This is a job within the ability of most people if they are willing to follow carefully a few directions.

The Following Materials Are Necessary: A door the proper size and shape for the opening, hinges, screws of the proper length. (See page 8.)

The Following Tools Will Be Needed: A pencil, small wood drill, screwdriver, and possibly a jack plane and a hand saw.

The Following Plan Will Work Very Nicely.

1. Fit the door to the opening. Just enough space should be left to make sure that the door does not bind. Doors are usually made a trifle larger than the opening so they can be cut to fit. (See How To Plane An Edge, page 10.) Notice that the lock stile must be slightly beveled to allow for the swinging of the door.
2. Locate the hinges on the hinge stile of the door, so that the pin will come directly over the crack between the door frame and the hinge stile. Hinges should be equally spaced from top and bottom.
3. Locate and drill the anchor holes in the door. (See page 8.)
4. Fasten the hinges in place with the screws.
5. Wedge door in place as shown in Fig. 449. The space between the door and the frame should be the same all the way around.
6. Fasten the other leaf of the hinges to the door frame. (See 3 and 4.)
7. Remove the wedges and test the door. It should swing freely, and close without binding.

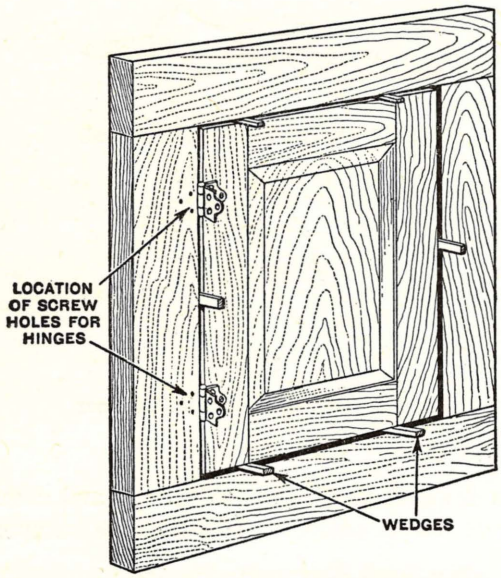


Fig. 449—A door should be held in place with wedges while the locations of the screw holes are marked

JOB NO. 96

HOW TO HANG A SMALL DOOR WITH BUTT HINGES

It is often necessary to hang a door with butt hinges. While this is not as easy as with surface hinges, it is within the ability of the household mechanic if he follows directions closely.

Be Sure That You Have the Following Materials: Hinges large enough to carry the door easily, and flat head screws that fit the hinges. Brass screws are best.

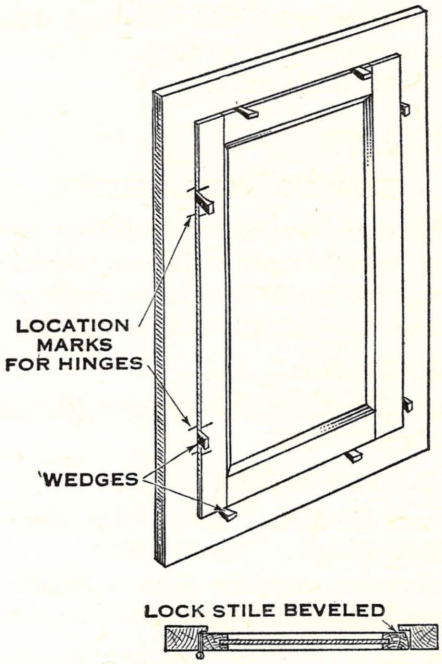


Fig. 450—A small door is fitted in the opening with the lock stile slightly beveled to allow for the swing

The Following Tools Should Be Ready For Use: A knife, gage, small wood drill, wood chisel, and screwdriver.

Here Is a Good Way to Do the Job. You should check each step in order to be sure not to miss any.

1. Fit the door to the opening. Enough space must be left to make sure that it does not bind. Doors are made larger than the opening so they can be cut to fit. Notice that the lock stile must be slightly beveled or rounded to allow for the swinging of the door.
2. First locate the hinges on the door and frame; then mark the location with a knife or chisel. The door should be held in the proper position with wedges while marking the location of the hinges. The hinges should be located near the top and bottom rails of the door. (See Fig. 450.)
3. Gain the leaves of the hinges into the door and frame. Outline the leaf of the hinge with a knife. The gain should be as deep as the thickness of the leaf of the hinge. (See Fig. 451.)

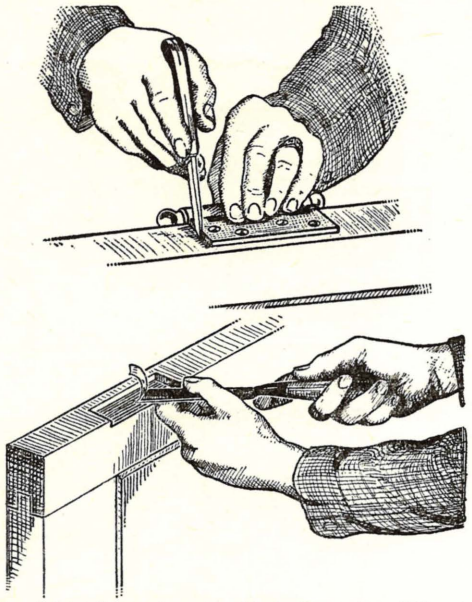


Fig. 451—A butt hinge is gained into the edge of the door and fastened with screws. (*a*) Mark location of the hinge with a knife. (*b*) Remove the wood with a chisel

4. Mark the location of pilot holes for the screws, and drill the holes smaller than the shank of the screws to be used. Do not attempt to drive screws without boring pilot holes, for the wood may split.
5. Fasten the hinges in place with screws. If the hinge has a riveted pin, it should be attached to the door first; then the door is held in place while the hinges are attached to the frame. If loose-pin hinges are used the leaves should be separated and attached to the frame and door separately.
6. Test the door by opening and closing it. If the hinge binds so that the door will not close, the gains may be too deep. Put a cardboard shim underneath the hinge. If there is a wide space between the frame and the hinge stile, the gain is not deep enough. Remove the hinges and cut the gain deeper. It should never be necessary to plane off any of the door because the door was fitted before the hinges were attached.

If You Can Answer "Yes" to These Questions, You Have Done a Good Job.

1. Are the hinges neatly gained into the door and frame?
2. Does the door operate properly?
3. Are all screws neatly driven?

Locks and Catches

A wide variety of locks and catches have been designed for the purpose of keeping doors and lids closed. The type used varies with the kind of door, location, purpose, and the design of other hardware. The types discussed here will be found in most homes.

The outside door lock is usually the most expensive lock found in the home. It is made to match the design of the house, as well as to meet the needs of the home owner. It includes the regular door latch, a bolt, and a night lock controlled by two buttons in the edge of the door. When the night lock is on, the latch may not be operated from the outside except with a key. The bolt may be operated only from the inside. The lock itself

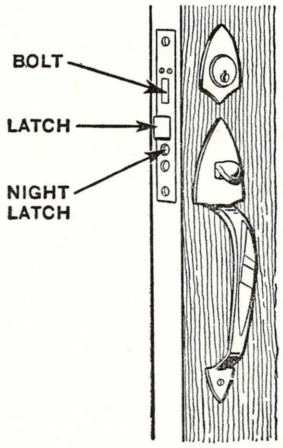


Fig. 452—A type of outside door lock

is usually of the cylinder type, and requires a flat, or Yale type key. The entire mechanism of the outside door lock is mortised into the edge of the door. (See Fig. 452.)

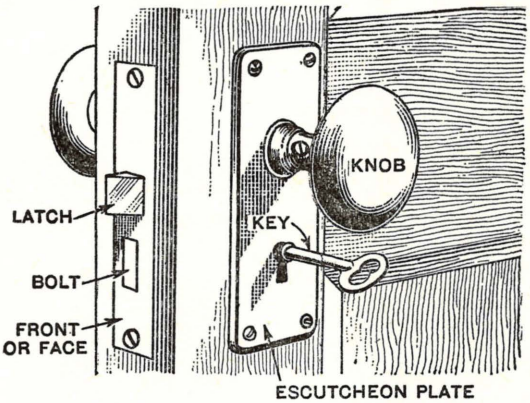


Fig. 453—The common mortise door lock used on inside house doors

Locks used on inside doors are usually simpler in construction than those used on outside doors. They are usually mortised into the edge of the door. The escutcheon plate and knob are usually designed to harmonize with other hardware. The prong or bit type key is most common. The inside door lock

found in most homes has the regular door latch and bolt. More expensive ones may be purchased containing a night lock of the same type as found on the outside door lock.

Night locks of many kinds may be purchased to install on doors which do not have a good lock.

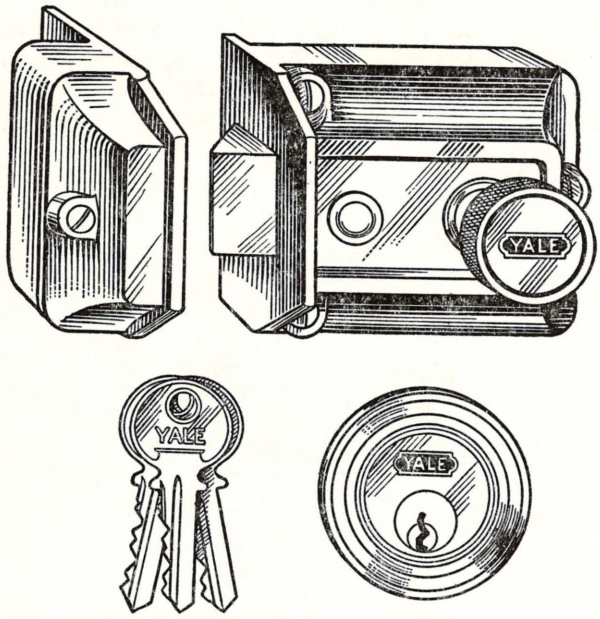


Fig. 454—Night lock for hinged doors

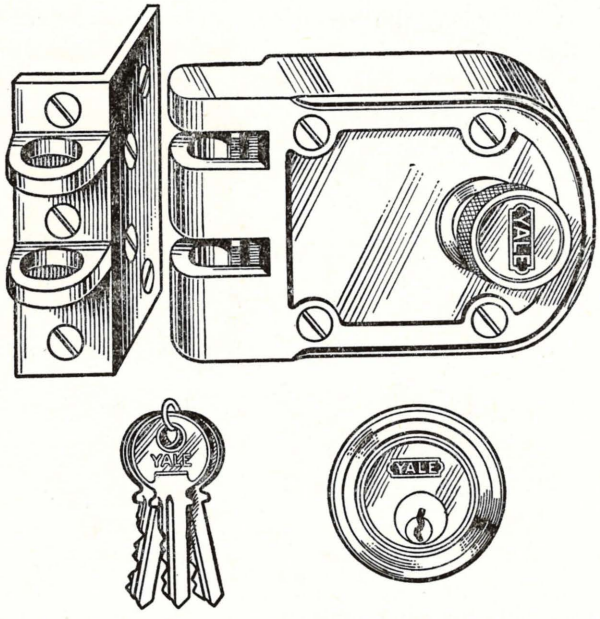


Fig. 455—Night lock for sliding doors

They do not take the place of the regular door latch, but are usually installed in addition to it. The lock is usually of the cylinder type, and requires the flat, or Yale type key.

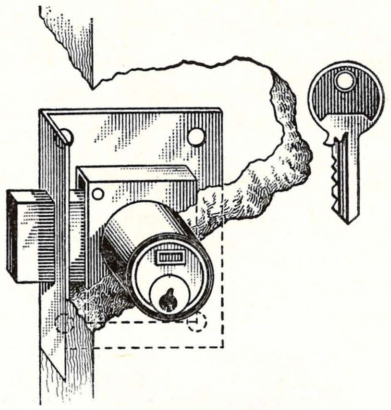


Fig. 456—Wardrobe lock

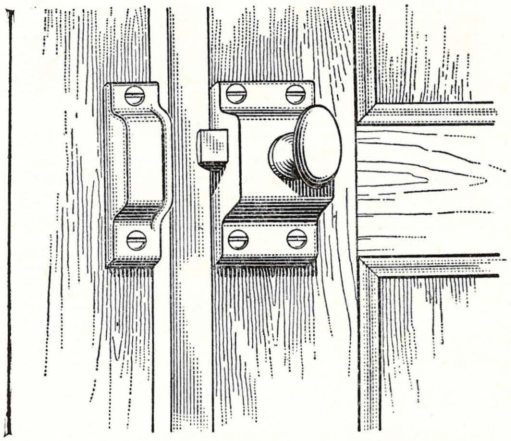


Fig. 457—Old style cupboard door catch

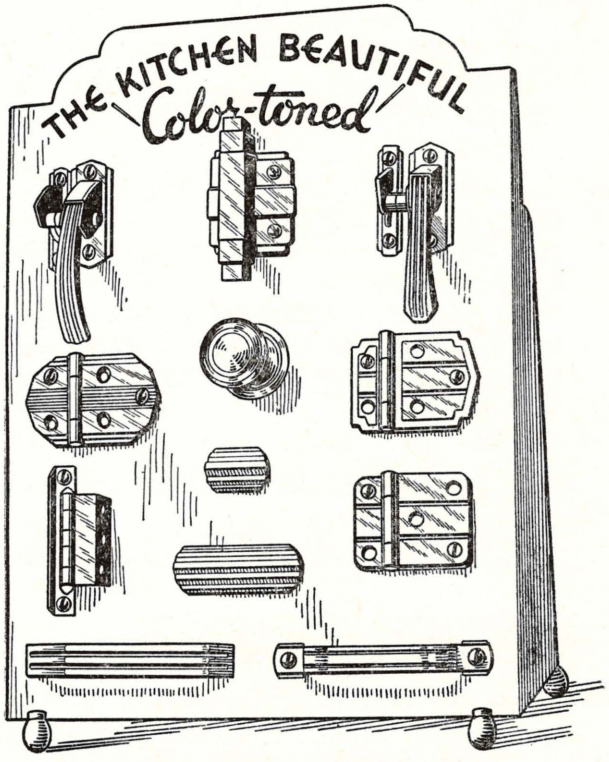


Fig. 458—Types of locks and catches

There is also a wide variety of locks and catches designed for wardrobes and cupboard doors. They differ so widely that description is difficult. Figs. 456-457-458 illustrate a number of types.

The Care of the Cylinder Type Lock

There is little the household mechanic can do in the way of repair to a cylinder-type lock. Its mechanism is so complicated that only the skilled workman having special training and equipment should attempt to take it apart. But there is much the household mechanic can do in giving it the proper care.

JOB NO. 97

HOW TO LUBRICATE A CYLINDER TYPE LOCK

The best kind of lubricant for the cylinder type lock is graphite. Oil becomes gummy and stiff in cold weather. The lead in the ordinary lead pencil is a good grade of graphite. When it is difficult to operate the key, the lock usually needs lubricating.

It will be much easier to lubricate the lock if the cylinder is removed, although it is sometimes necessary to do the job while the cylinder is still in the door.

Materials Necessary:

A lead pencil, jack knife, screwdriver, and pair of pliers will usually do the job.

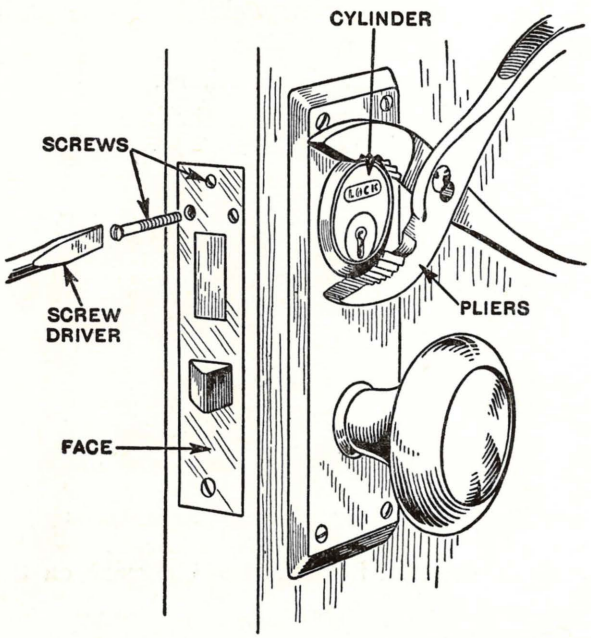


Fig. 459—The cylinder may be removed with a screwdriver and a pair of pliers

Here Are Some Suggestions For Doing the Job:

1. Remove the cylinder. This can be done by loosening the screws in the edge of the lock which hold the cylinder in place, and turning the cylinder out with a pair of pliers.
2. Shave the lead of the ordinary soft lead pencil into a fine powder on a piece of paper.
3. Using the paper as a funnel, pour, or gently blow the fine-powdered graphite into the key slot of the cylinder. It may help to tap the outside of the cylinder in order to get the graphite into the key slot.
4. Operate the key in the cylinder a number of times in order to get the graphite distributed through the mechanism.
5. Replace the cylinder and operate the lock.

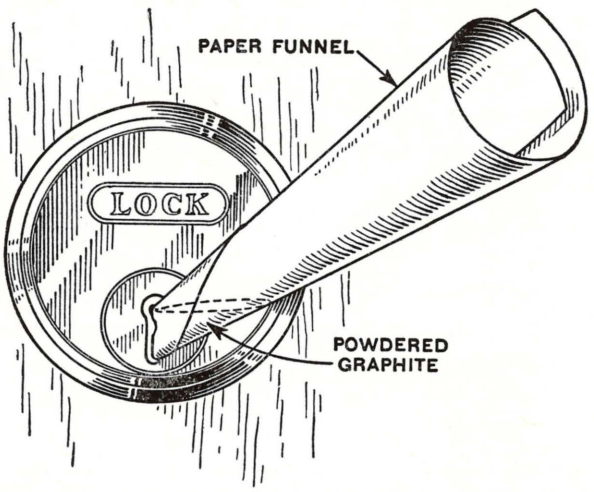


Fig. 460—Powdered graphite may be poured or blown into a cylinder lock to lubricate it

Note: A much slower, but easier method is to rub the key with the lead of a soft pencil before inserting it into the slot. This must be done many times in order to get enough graphite into the lock to do any good.

JOB NO. 98

HOW TO THAW OUT A FROZEN LOCK

Outside door locks and the locks on automobile doors are exposed to the weather and often become partly filled with water. It takes only a small amount of water to freeze a lock so that it will not work. Forcing the lock gets no results, and is apt to result in a broken key. Here are a few suggestions for freeing the lock.

1. Heat the key with a match or torch and insert it in the lock. This will probably have to be done several times.

2. Another method is to insert the key in the lock, and heat the handle portion of the key while it is still in the lock. This can be done with matches, a cigarette lighter, or a torch. Care should be taken not to burn the paint around the lock. Enough heat is soon carried into the lock to melt the ice.
3. Prevent the lock from freezing again, by squirting in a little alcohol into the lock with an oil can. Then lubricate the lock with graphite as explained in Job No. 97.

JOB NO. 99

HOW TO GET A NEW KEY

When the key to a cylinder type lock is lost or broken off in the lock, something must be done about it immediately. This kind of lock cannot be worked with a hairpin or bent wire. The household mechanic is not equipped to make a new one, so he should know what to do. There are several things he can do.

1. Remove the cylinder and take it to a locksmith. He is a skilled mechanic who is equipped to make a key. (See Job No. 97.)
2. If an extra key is desired, take the key now being used to a locksmith, or to most any hardware store. They can make a duplicate in a few minutes.
3. If the door is locked and the key is lost, the next best thing to do is to call the locksmith. He will know what to do.
4. Avoid future situations of this kind. It is always a good idea to have a duplicate key concealed in some place where it can be used in emergencies, and where its location is known only to the owner. An extra car key carried in the bill fold has saved many embarrassing situations.
5. Never use a pair of pliers to turn a key. If the fingers are not strong enough, something else should be done. The key is not strong enough to stand the leverage of a pair of pliers and is apt to break off in the lock.

The Care of the Inside Door Lock

While the lock on an inside door may not be used very often, the door knob is used very frequently. Also, it is very aggravating to have occasion to lock a door and not be able to do so. Most of the service required can be given by the household mechanic.

JOB NO. 100

WHAT TO DO WHEN THE LOCK ITSELF DOES NOT WORK PROPERLY

The Only Tools Needed Are: A screwdriver, a small file, and some lubricating oil.

The Following Plan Is a Good One to Follow:

1. Locate the trouble, if possible, by operating the lock. If the knob or escutcheon plate is loose, the screws can be tightened without removing the knob.

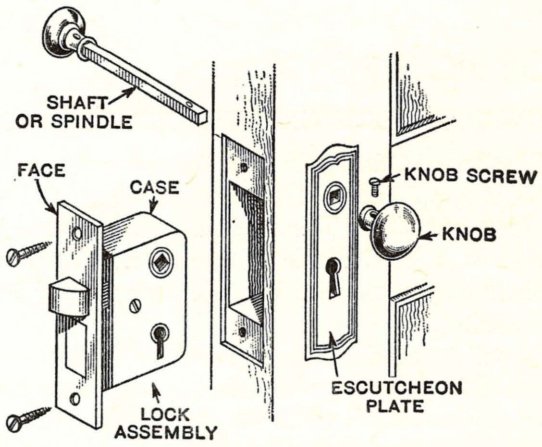


Fig. 461—The mortise lock can be removed from the door for adjustments and oiling

2. If the trouble is inside, remove the lock as follows:
   (*a*) Remove the screw which holds the knob on the shaft, or spindle.
   (*b*) Remove the knob and spindle.
   (*c*) Remove the screws from the face.
   (*d*) Remove the lock.

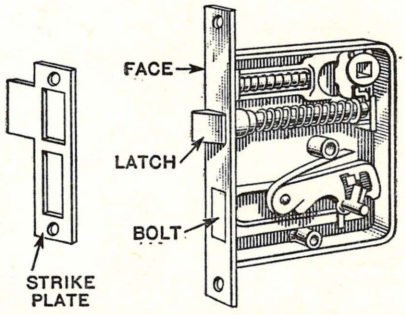


Fig. 462—A mortise lock opened for inspection

3. Open the lock by removing the screw on the face of the lock case.
4. Study how the parts operate.
5. Make the necessary repairs:

(*a*) If it is rusty, oil it.

(*b*) If a spring is broken, make a new one out of a piece of spring steel. An old clock spring is excellent.

6. Assemble the lock and test it.

Did You Succeed Well? Answer these questions before you decide.

1. Have the parts been damaged by careless handling?

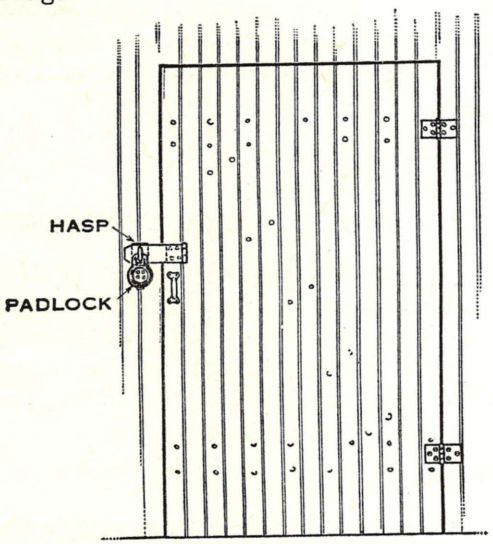


Fig. 463—A door locked with a padlock

2. Have the screw heads been damaged by the screwdriver?
3. Does the lock operate easily and surely?

The Hasp and Padlock

A padlock is often used on the doors of shops, garages, and outside buildings which need to be kept locked. It is a simple method of protecting property against the raids of the ordinary prowler. But a padlock, no matter how good, is no safer than the hasp to which it is attached.

JOB NO. 101

INSTALLING A HASP FOR A PADLOCK

Tools You Will Need Are: A drill and a screwdriver.

The Only Materials Necessary Are: A hasp and screws. The hasp may be installed with bolts instead of screws.

Here Is the Way to Install a Hasp.

1. Locate the hasp just above or below the door handle. It should be installed so that all screws are covered when the hasp is closed.
2. Locate the screw holes for both parts of the hasp.
3. Drill the pilot holes for the screws.
4. Fasten the hasp in place with screws.
5. Test the hasp to see that the leaf swings freely over the staple.

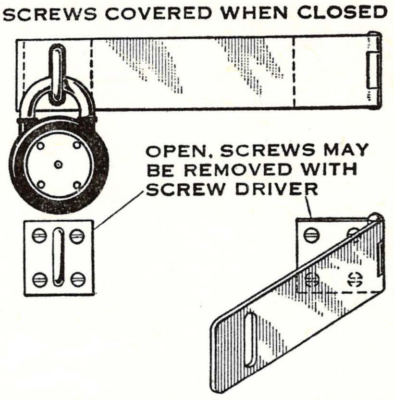


Fig. 464—A hasp and staple properly installed cover the screws when locked

Have You Done a Good Job? Judge for yourself by answering these questions.

1. Is the hasp solid enough to stand the necessary strain?
2. Does the hasp fit?
3. Are the screws exposed when the hasp is closed?

An ordinary hasp, locked with a padlock, is not burgular proof, because the hasp can be twisted off easily with a monkey wrench. A hasp has been designed to foil even this attempt to break into buildings. The hasp, instead of shutting over a staple, closes over a rod which turns readily and cannot be twisted off.

Shooting Door Trouble

Doors do require attention if they are to give satisfactory service. The trouble can often be remedied quickly and easily with the aid of a few simple tools. But the household mechanic should know just how much of a job he is prepared to do. Some jobs should be left for the carpenter who is skilled in that kind of work, and who has the special tools necessary. It will be well to remember that the door which is now giving trouble, once operated perfectly. Something has happened to it since it was installed. Before cutting a door, a careful check should be made to discover the cause of the trouble. Doors are often ruined by careless cutting.

Check These Things When a Door Does Not Operate Properly.

1. Is the house damp? Has the door swollen? Most houses are damp during the summer. If

the door has swollen, the paint or varnish job has not sealed the wood. The door will dry out again during the winter when the furnace heat is on. Of course, doors must operate in the summer, but it is a good idea not to remove any wood if it can possibly be avoided. When the door dries out during the winter, it should be resealed with paint or varnish, being very

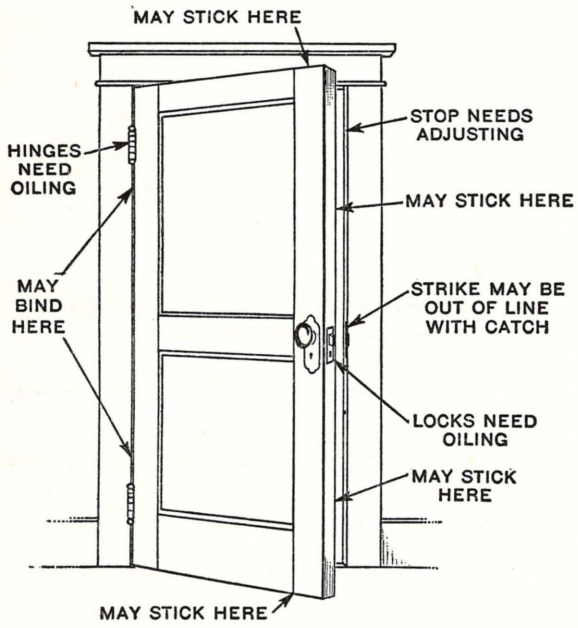


Fig. 465—Doors need attention to make them operate properly

careful to seal the top and bottom of the door. (See Job No. 102.)

2. Has the house settled on the foundation? Perhaps the framing timbers have changed their location. This condition sometimes pulls a doorway out of line. When this is true, the household mechanic will do well to call a good carpenter and turn the job over to him. It is not a job for the amateur.
3. Are the hinges and other hardware securely fastened to both door and jamb? The household mechanic should be able to handle this job. (See Jobs No. 95, 96, and 102.)
4. Has the door warped? This job is usually too complicated for the amateur. Usually a warped door can be straightened, but the process requires much skill, good judgment, and special equipment.

JOB NO. 102

HOW TO REPAIR A DOOR THAT STICKS

The most common ailment of doors is sticking. This may be caused by swelling, loose hinges, or settling of the house. If the door is not too badly out of line it may be repaired by the household mechanic. If the frame is badly out of line, the job should be done by a carpenter.

Tools and Materials Necessary:

A hammer and screwdriver are almost always necessary, and often a plane and wood chisel. Paint or varnish is needed when wood is removed.

Here Is a Good Plan to Follow:

1. Inspect the door and hinges. Find out where the door sticks. Loose hinges should be tightened. (See Job No. 92.)
2. If the door still sticks, study the door very carefully and compare it with the doors shown in

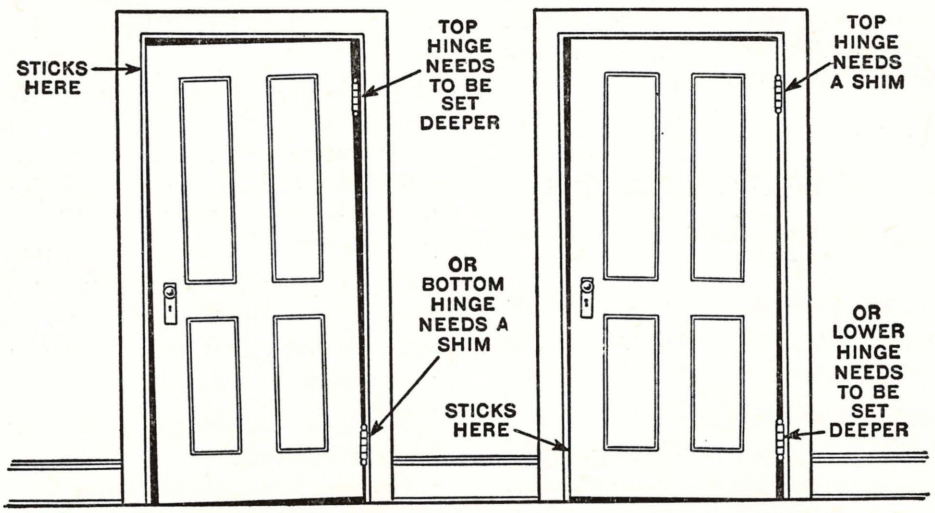


Fig. 466 (*a*) and (*b*)—A shim placed under a hinge will often free a door that sticks

Fig. 466. It is possible that a shim under one of the hinges will free the door. (See Job No. 93.)

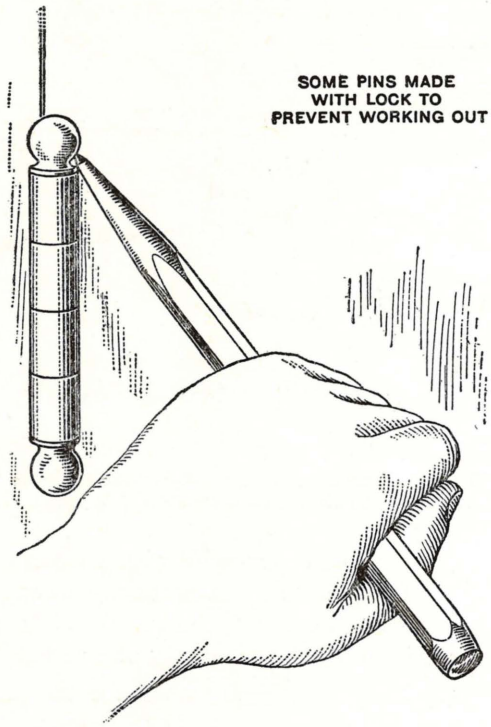


Fig. 467—The hinge pin may be driven out with a center punch and a hammer

3. If shims under the hinge do not free the door, it may be possible that the other hinge needs to be gained deeper into the jamb. However, if the hinge stile of the door fits tightly against the jamb, this will not remedy the trouble.
   (*a*) Remove the door. If the door has a loose pin butt hinge, the pin may be driven out with a center punch and a hammer.
   (*b*) Remove the hinge leaf from the jamb with the screw driver.
   (*c*) Cut the gain deeper with a wood chisel. The depth can be increased only by the amount of space there was between the hinge stile and the jamb when the door was closed.
   (*d*) Replace the hinge leaf.
   (*e*) Replace the door. In replacing a door, the upper hinge should be fastened first.
4. If the above remedies have not worked, or have not seemed practical, the household mechanic can still plane the top or bottom of the door.
   (*a*) Remove the door. (See 3a above.) Remember to take the pin from the bottom hinge first.
   (*b*) Remove one or two shavings from the worn areas with a plane. The door will show wear where it has been rubbing against the jamb.

   Caution: In planing across the end grain of the lock stile or hinge stile, be sure to plane from the outside edge toward the inside. Otherwise the plane is apt to splinter the edge.
   (*c*) Replace the door and test. Repeat if if necessary.
   (*d*) Seal the planed areas with paint or varnish to prevent the absorption of moisture.
5. If the above remedies have not worked, or if the door is still too large for the opening, the hinge-stile will have to be planed and the hinges reset. This is a difficult job for the household mechanic, and should be given to a carpenter if the household mechanic is in doubt about his ability.
   (*a*) Measure the amount to be removed by marking the overlap on the door jamb.
   (*b*) Remove the door and hinges.
   (*c*) Mark the amount to be removed with a straight edge and pencil on the hinge stile.
   (*d*) Plane to the line. Do not plane any more.
   (*e*) Cut the gains for the hinges deeper by the same amount with a wood chisel.
   (*f*) Reseal the edge of the door with paint or varnish.
   (*g*) Replace hinges and rehang door.

JOB NO. 103

WHAT TO DO WHEN THE LATCH WILL NOT CATCH

Usually, if a door is fitted properly when installed, the house will not settle enough to pull the doorway out of line. But whatever the cause may be, when the latch does not catch, it should be repaired. A number of conditions will determine the remedy. Study the situation carefully and select the remedy best suited.

1. The doorway may be too wide. The latch does not engage the strike enough to hold.
   (*a*) Place cardboard shims under both hinges, as described on page 155, or,

(*b*) Remove the strike and put enough cardboard shims under it to allow the latch to enter the strike, or,

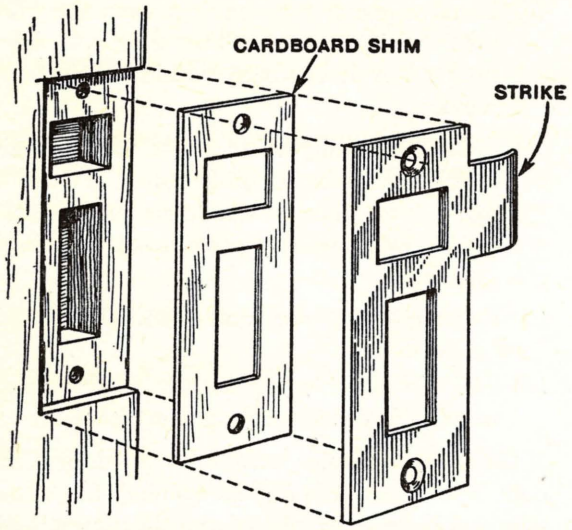


Fig. 468—Cardboard shims may be cut to put under the strike

(*c*) Sometimes it is necessary to do both of these things.

2. The strike may be out of line with the latch.
   (*a*) If the latch is only slightly out of line with the hole in the strike, the bottom or the top of the hole may be enlarged with a file. The filing may be done much easier if the strike is removed.
   (*b*) It may be necessary to move the strike up or down on the door jamb to make the latch enter the hole.
      (1) Close the door just enough to allow the latch to touch the strike.
      (2) With a lead pencil, mark the points where the latch touches the strike. This will show the distance the strike will have to be moved up or down.
      (3) Remove the strike.
      (4) Plug the old screw holes with wooden pegs. (See page 154.)
      (5) Move the strike up or down the required distance and trace with a pencil.

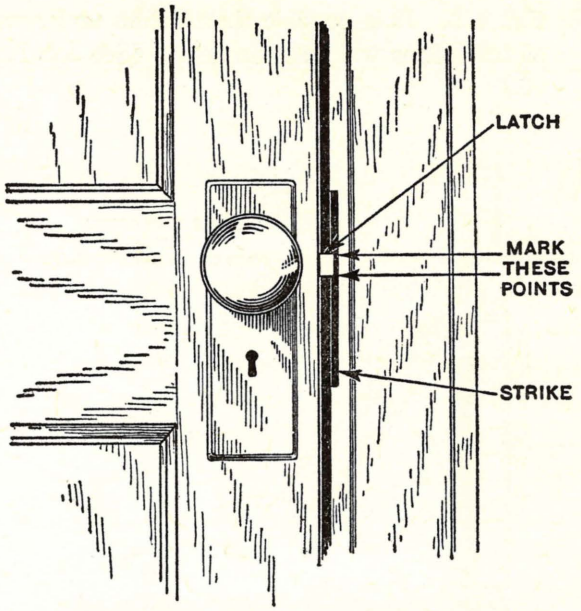


Fig. 469—The distance up or down the strike is to be moved should be marked with a pencil

      (6) Enlarge the mortise with a wood chisel. It will usually be necessary to cut only a small amount, because the old mortise is sufficient for most of the plate.
      (7) Drill new anchor holes for the screws. (See page 8.)
      (8) Replace the strike.
      (9) Test. It may be necessary to cut away enough wood under the hole in the strike to allow the latch and bolt to penetrate their full length.
      (10) Space left between the old location of the strike and the strike may be filled in with plastic wood and touched up with paint.

3. The door may rattle. This usually happens when the strike is set too far away from the stop to hold the door firmly against the stop. The best remedy is usually to move the strike back toward the stop. (See 2 above.) It is not usually practical to move the stop because of the finishing problem. The entire door jamb might have to be refinished.

The Care of Windows

Chapter 7

WINDOWS deserve much attention because they add to the comfort, usefulness and beauty of the modern home. When viewed from the outside, windows can effect the design and character of the entire building. When viewed from the inside, each window frames a picture of the outdoors. Cross ventilation is desired in the summer, so windows should be placed to allow good circulation of outdoor air. In winter, too many, or too large windows raise the heating cost because of heat loss through the glass. The number, size and shape of windows govern the amount of light admitted to a room, and thus affect the health and comfort of those living in the home. It is with these things in mind that the household mechanic is urged to learn to care for windows.

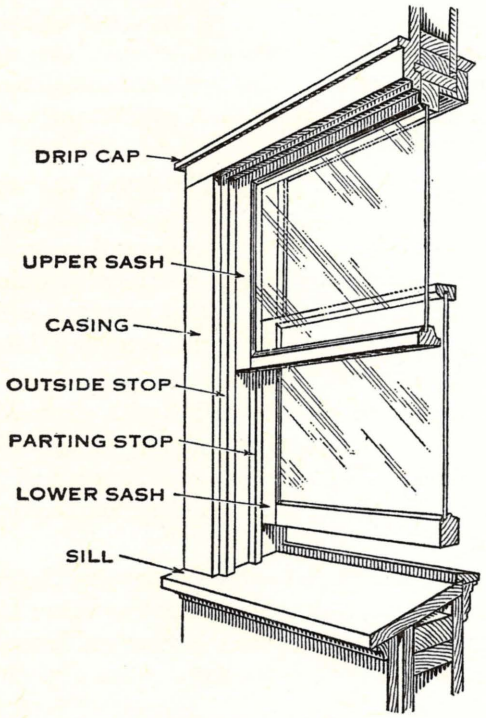


Fig. 470—A double-hung window and its parts. Outside view

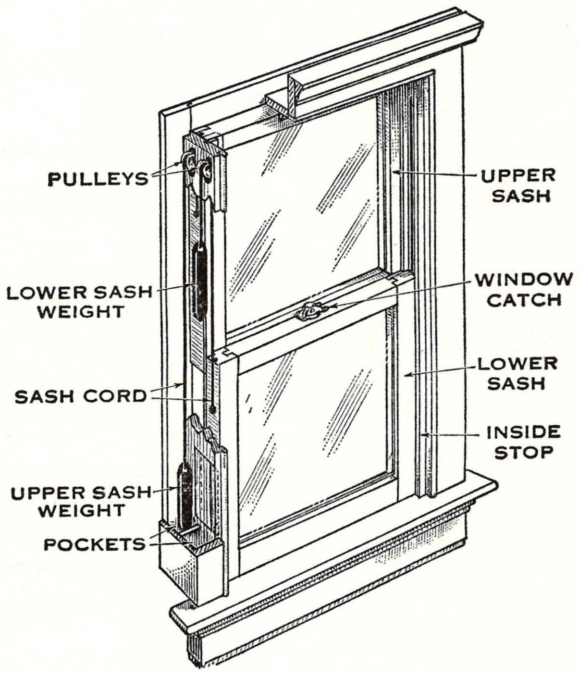


Fig. 471—Section view showing location of sash. Inside View

Wood Windows

For many years the wood sash and window frame has been the most common type for homes. The window in the modern home may contain one, but usually two sash. A sash is a frame which holds the lights, or panes, of glass. There may be one or many lights in a sash. A window in which the sash is hung on hinges is called a casement window.

A window having an upper and a lower sash is called a double-hung window, as shown in Fig. 470. The double-hung window is opened by raising the lower sash or lowering the upper sash. Various mechanical devices have been invented to make the operation of the sash easy. In older homes the sash are usually counterbalanced on both sides with heavy iron weights hung on sash cords, which run over pulleys at the top of the window casing. In newer homes the sash are often counterbalanced by spring devices, fastened to the sash and casing. This type of counterbalance allows more wall or light space because space for the weight pockets is not necessary.

The sash are held in place by strips of wood or metal called stops. The sash operate up and down between these stops. Notice that the upper sash overlaps the lower sash on the outside of the window,

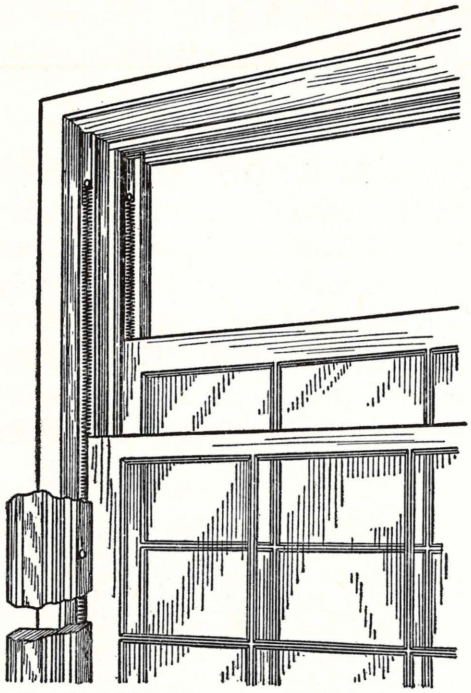


Fig. 472—The spring type of counterbalance

as shown in Fig. 470. This is to prevent rain from coming through between the sash at this point. If the stops fit too closely to the sash there will be difficulty in raising or lowering the sash. The rubbing surfaces had better be oiled. Wood stops must be kept painted, and paint is apt to cause them to stick. They must be freed after each painting. The new type metal stops are used as both stops and weather stripping. They do not usually stick, and the working surfaces do not require painting, since they are made of rust-proof metal. A carpenter can install metal weather stripping on old windows.

JOB NO. 104

RECOVERING LOST WINDOW WEIGHTS

Occasionally the weights which counterbalance the sash break, or come untied. This causes the sash to bind when moved up or down, because it is overbalanced on one side. Remedying this difficulty is not half so hard as it sounds.

If the Old Cord Is Broken, the Only Material Needed Is a New Sash Cord About One Sash Length Longer Than the Window.

The Following Tools Will Come in Handy: A wood chisel, or a strong knife for removing the window stop, and a screwdriver for removing the door of the pocket and the window stop, if held with screws. (See Fig. 474.)

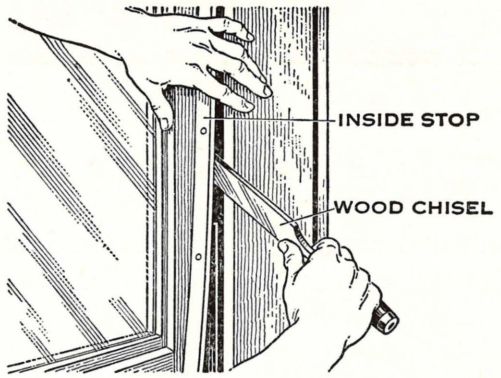


Fig. 473—Great care must be exercised in removing a window stop or it will split and the window casing will be damaged

Here Is a Good Plan for Doing the Job.

1. Remove the inside stop from one side of the window. Take care not to split the stop or mar the casing. The stops are sometimes held in place with screws that pass through slotted washers.
2. Raise the lower sash to the top of the window. Otherwise the door to the pocket will be partly hidden by the sash. If the cord is broken, it will be necessary to remove the sash which can be taken out easily. A knot must be tied in the cord to prevent it from dropping into the weight pocket.
3. Open the door to the pocket with a screwdriver. Now, it is necessary that you judge what is needed. The weights may be reached easily with the hand. Is the cord broken or just untied? (See Fig. 474.)
4. Retie, or replace the cord. In tying the cord to the weight, a double slip knot or halter hitch is used. A small knot in the other end is needed to fasten the cord to the sash. (See Fig. 475.)

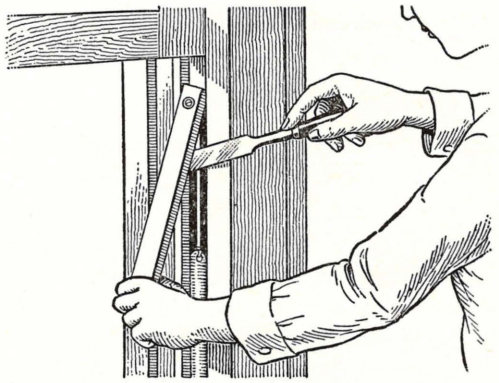
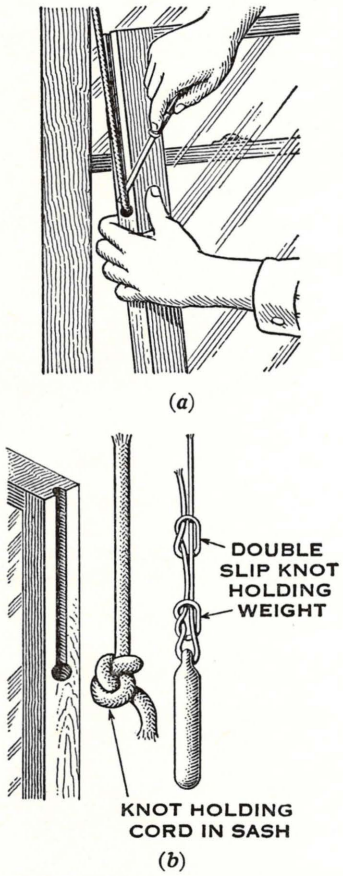


Fig. 474—The opening to the window weight pocket is under the window stop. The weight pocket can be opened by removing the screw which holds the small door in place

5. Replace the weight in the pocket and put the sash back in place. Move the sash up and down several times to see that it works properly. The cord must be long enough to permit the sash to be raised or lowered all the way, and short enough so that there is no slack in the cord at any time. Lengthen or shorten the cord if necessary.

6. Replace the parts you have removed, being careful not to damage the woodwork.



(*a*)

(*b*)

Fig. 475—(*a*) Removing the sash cord. (*b*) The window weight is made of cast iron. The cord is tied through an eye in the end of the weight with a double slip knot

Here Is a Scale Whereby You May Appraise Your Work:

1. Can the lower sash be closed?
2. Is the woodwork marred by the careless use of tools?
3. Does the weight work when the sash is raised to the top of the window?
4. Can both upper and lower sash be operated easily?

JOB NO. 105

ADJUSTING A WINDOW THAT STICKS

An endless amount of energy is wasted in trying to open and close windows that stick. Sometimes a great amount of patience, as well as mechanical skill, is necessary in repairing one of these.

In the first place it should be remembered that the window operated when it was originally installed. The fact that it does not operate properly now, is due to something which has happened since it was installed.

Here Are a Number of Conditions Which Cause Windows to Stick or Rattle and Suggestions for Remedying Them. (See Fig. 476.)

A. **Dampness.**

If dampness causes the sash to stick, it is probably because the sash needs a new coat of paint or varnish. Otherwise dampness would not affect it.

Caution: It is not a good plan to plane the edge of the sash or the stops. When the weather is dry again, the sash will shrink and become loose, causing it to rattle in the wind.

B. **Settling of the House.**

In this case the whole window frame is out of square. Adjustments will require the services of someone experienced in the construction of window frames. Because it is a skilled mechanic's job, do not try it unless you have had experience.

C. **Paint or Ice Between the Sash, or Casing, and the Stop.**

This is a common cause of window sticking.

Insert a strong, thin bladed knife between the sash and the stop both inside and outside. The knife, drawn several times the full length of the sash, should loosen it from the stop. If this does not loosen it, the trouble is probably between the sash and the casing.

Try to jar the sash loose by striking it with the palm of the hand. Be careful not to break the glass, for the hands may be badly cut.

Insert a chisel underneath the sash from the outside and pry carefully. Be careful not to spoil the sash, or break the chisel. (See Fig. 476.)

As a last resort remove the stops and take out the sash. Then the sash may be cleaned of paint or ice so that it will work properly.

Soap, oil, or paraffin applied to the sliding surfaces will make the sash operate more smoothly. When the house is painted, the sash should be removed.

How Well Did You Do the Job? These questions may give you an idea.

1. Has the woodwork been marred?
2. Is the sash too loose? Will it rattle in the wind?
3. Does the sash operate smoothly, and does the sash lock come together?

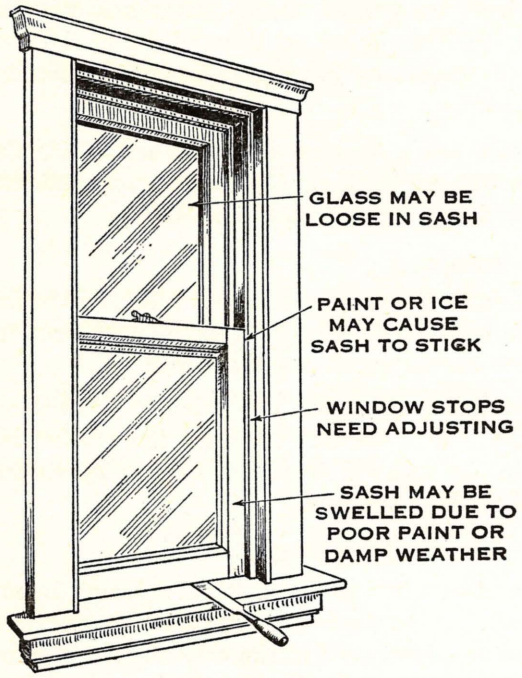


Fig. 476—It is necessary to examine a window carefully to determine exactly what is the matter before tinkering with it

Weatherstripping

On windy days in the winter cold air enters the house through the spaces between the sash and the window frame. This causes the house to be uncomfortable and drafty near windows. It also requires more fuel to keep the house comfortable. Some form of weatherstripping may be used to prevent this. Many types of weatherstripping are available. Some of the common types are illustrated here.

Some types of weatherstripping can be installed by the household mechanic, and will greatly improve old windows. In most communities there are firms which make a specialty of installing weatherstripping in the windows of old houses. House builders are now buying ready-built windows and installing them in new house construction. Such windows are built with weatherstripping as a part of the original window construction.

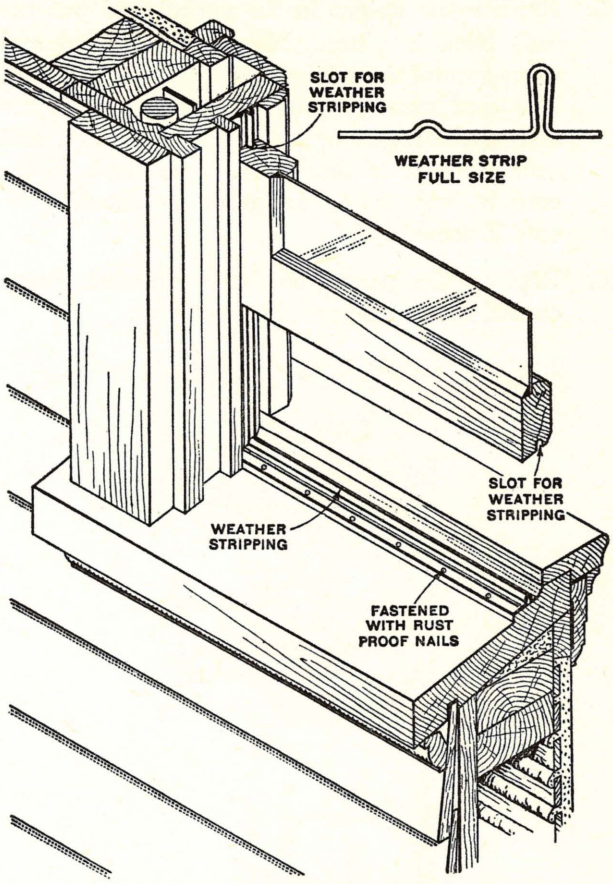


Fig. 477—A very efficient type of weatherstripping which should be installed by a carpenter

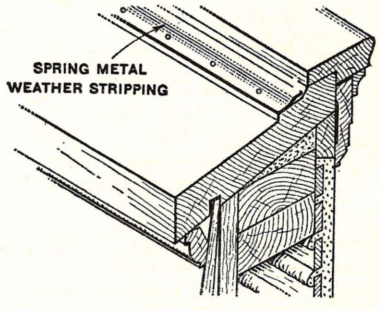


Fig. 478—Spring metal weatherstripping may be installed by the household mechanic

JOB NO. 106

HOW TO WEATHERSTRIP A WINDOW

The household mechanic may save fuel and add to the comfort of the home by weatherstripping the windows. It requires the use of only a few simple tools and materials. Many kinds of weatherstripping have directions included with the material.

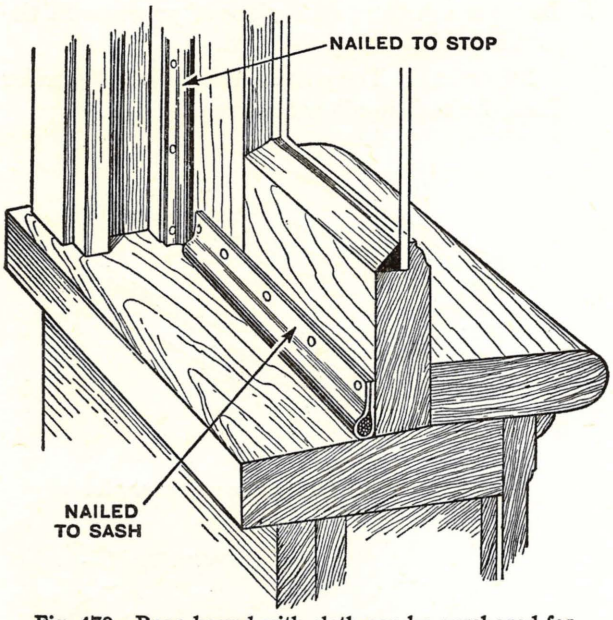


Fig. 479—Rope bound with cloth can be purchased for weatherstripping and installed by the household mechanic

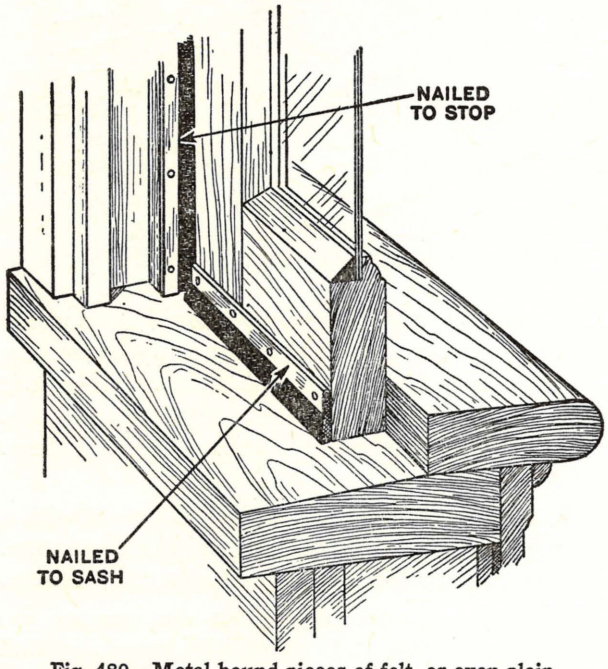


Fig. 480—Metal bound pieces of felt, or even plain pieces of felt are often nailed to the sash or parting stop for weatherstripping

The Tools Necessary to Do the Job Are: A hammer, a rule or tape measure, and a pair of tin snips.

The Materials Necessary: The household mechanic usually has a choice of several forms of weatherstripping, Fig. 478. The type shown in Fig. 477 should be installed by a carpenter. Weatherstripping is sold usually by the foot, so it will be necessary to measure the window. Allow a few inches for waste, as the material cannot be jointed. Brass, or rust-proof galvanized nails will be necessary for nailing.

Here Is a Suggested Plan for Doing the Job.

1. Measure the window to be weatherstripped. Stripping will be needed for all four sides of each sash, but measure for the joint of the upper and lower sash only once.
2. Buy the amount of weatherstripping needed.
3. Cut length needed for bottom of lower sash. Spring metal stripping should be measured with the window raised because it extends to the frame inside the stops. Rubber and fiber may be measured and cut with the sash lowered.
4. Nail stripping in place. (See Figs. 479 and 480.)
5. Measure for the sides of the lower sash. The stripping should be long enough that it reaches the entire length of the sash.
6. Cut to length and nail in place. (See Figs. 478-480.) Spring metalstripping is nailed to the casing between the stops, so it will be necessary to raise the lower sash as high as possible. Rubber and fiber stripping is nailed to the stops and may be installed with the window closed.
7. Measure for the joint of the upper and lower sash.
8. Cut to length and nail in place. The stripping should be nailed to the bottom of the upper sash.
9. Finish the upper sash in the same manner as the lower sash.

WINDOW GLASS

Window glass, polished plate glass, figured glass, frosted glass, and art glass are used in windows and other places in the home. Window glass is made by a continuous process and is known as drawn glass. It is made in two qualities, A and B, and in several thicknesses.

Single-strength glass is available at hardware stores in sizes up to 24″× 36″, but is not recommended for use in windows in sizes larger than 10″× 12″. It is too thin to stand the strain of wind and ordinary usage in the larger size.

Double-strength glass can be purchased in quite large sizes, but is not recommended for anything larger than 24″× 30″. As in the case of single-strength glass, the strain of wind and ordinary usage makes it impractical to use larger sizes.

Crystal sheet, or plate glass is recommended when windows larger than 24″× 36″ are desired. Plate glass is thick enough to stand the strain of wind and ordinary usage.

Polished plate glass is cast on a flat table, and both sides are ground to perfectly smooth surfaces having a high polish. The thickness varies from $\frac{1}{8}$″ to $1\frac{1}{4}$″, the usual thickness being $\frac{1}{4}$″. This thickness can be obtained in places up to 150″x260″, and is used mainly in store fronts.

Figured, frosted, colored, and art glass are used where light instead of direct vision is desired, as in bathrooms, etc. The household mechanic will be interested mainly in the single-strength and double-strength window glass.

JOB NO. 107

CUTTING GLASS

Often when a window pane is broken, enough of the glass may be saved to use for one or several smaller windows. Therefore, the largest pieces of glass should be put away where they will not be broken, and should not be cut until the size of the piece needed is known. Otherwise, the piece cut may not be the right size.

Fig. 481—The glass cutter

Cutting glass requires a skill which is easily acquired if one is willing to become acquainted with the proper methods, and do a little practicing. It is well to practice on a few pieces of scrap glass, to prevent spoiling a good piece.

If it is necessary to buy new glass, it is best to give accurate measurements to the hardware or paint dealer who will cut the pane the correct size. In buying new glass, single strength is suitable for small panes, such as are found in sash containing several lights. Double strength glass should be used in larger panes, such as single light sash.

The Only Material You Will Need Is a piece of glass large enough to supply the size you need and a piece of paper for the pattern.

Your Equipment Should Be as Follows: A solid flat top table large enough to lay the glass on while cutting, a straight edge, a glass cutter, and a cloth dampened with cleaning fluid or turpentine.

Here Is an Orderly Procedure for You to Follow. You will do well to follow it closely and check each step as you do it.

1. Lay out a pattern on a piece of paper to fit the sash in which it is to be used.

   Important! The pattern should be $\frac{1}{8}$″ smaller than the sash to allow for irregularities.

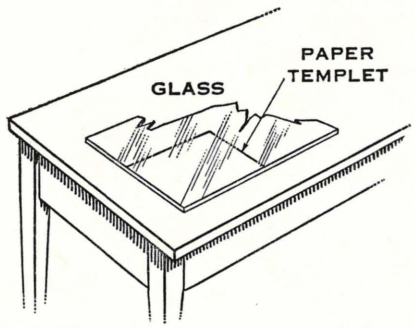


Fig. 482—Cutting glass over a paper templet

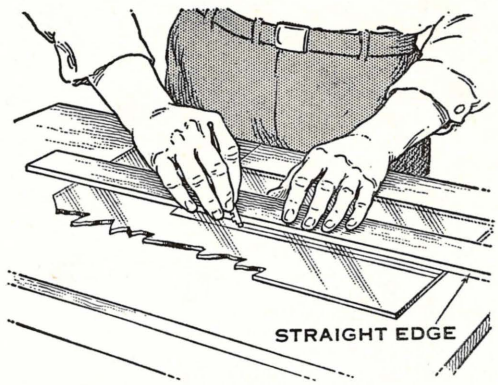


Fig. 483—It requires a little practice to cut glass successfully

2. Spread the pattern on a flat table top and lay the glass over it. If the glass is not absolutely flat, the hollow side should be up. When it is necessary to cut only two edges of the glass, lay the good edges on the lines of the pattern. (See Fig. 483.)
3. Clean the portion of the glass to be cut with a rag dampened with cleaning fluid or turpentine. The cutter will not work well on a dirty surface.
4. Lay the straight edge along the lines of the pattern. Hold it in place with one hand and draw the glass cutter over the lines of the pattern with the other hand. Be sure you are cutting over the line. Otherwise the glass may not be the right size. Do not attempt to go over the same line twice with the cutter. This spoils the cutting wheel.
5. Break the glass on the lines made by the glass cutter. This may be done in several ways. One way is to tap on the under side of the line with the handle of the glass cutter, and break

over the edge of the table. Be sure to hold the glass firmly so that it does not cut the hands when it breaks.

Safety Measure: Wear goggles while cutting glass.

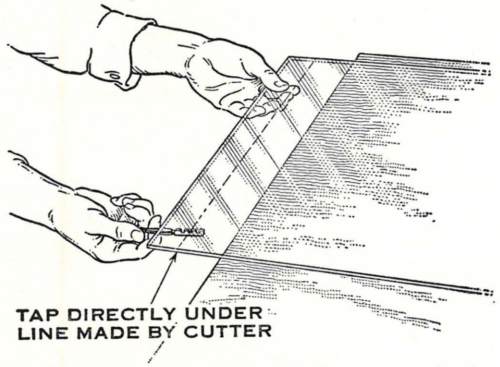


Fig. 484—The glass cutter cuts a shallow groove in the glass, which is then broken along the groove made by the glass cutter

Did You Do a Good Job of Cutting? You may judge by these points.

1. Is the glass the required size?
2. Are the edges ragged?
3. Did the glass break evenly on the line made by the cutter?

Glazier's Points

Glass is held in place in the sash by small pieces of metal called glazier's points. These are either driven or pressed into the wood of the sash before the final coat of putty is applied.

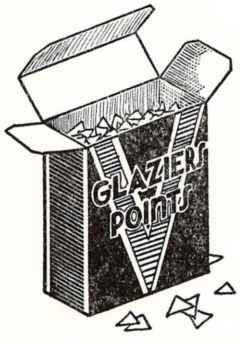


Fig. 485—Glazier's points can be pressed into place with a chisel or putty knife

Putty

Putty is a plastic material made of a pulverized chalk called whiting, mixed with linseed oil. Zinc oxide or white lead is sometimes added to make the putty more durable. The thick paste at the bottom of a can of paint makes an excellent putty when mixed with whiting. It makes an especially good putty for filling wall holes and cracks while painting, since it may be made the same color as the paint being used.

JOB NO. 108

HOW TO MIX PUTTY

There are situations in which you might wish to mix putty and also where you might wish to recondition some old putty which has become hard. However, for the occasional job of glazing, it is more economical to buy it already mixed. It may be bought in small containers which can be sealed again, keeping the putty soft for a long time. Putty will remain soft if kept covered with water in a can.

Fig. 486—A few drops of linseed oil mixed with whiting makes putty

Materials You Will Need: Whiting and linseed oil.

The Only Equipment You Will Need: A mixing board and a putty knife.

Your Success Will Depend Upon Your Doing the Work in an Orderly Fashion. Each step can be checked as it is done, insuring against mistakes.

1. Place a handful of whiting on the mixing board, and make a depression in the center. You will have to judge the amount you will need by the job you have to do. (See Fig. 486.)
2. Pour a small quantity of linseed oil in this depression. As not much oil is necessary, use only a small amount at first. More can be added if needed.
3. Using a putty knife, mix the whiting and oil until it becomes quite stiff. Oil may be added, a drop at a time, if needed.
4. Knead the mixture with the hands until it works easily, but does not stick to the fingers. If it

becomes too sticky, it can be rolled in whiting again until it is right. Putty should be soft and pliable so that it may be easily forced into all cracks around the glass and in the rebate.

Old putty which has become hard may be pulverized by pounding it with a hammer. Then it can be remixed with linseed oil. Frequent pounding while mixing helps to work out the lumps.

Judge the Quality of the Putty That You Have Made by These Points:

1. Is the putty soft and pliable?
2. Does the putty have lumps in it?
3. Does the putty stick to the fingers when kneaded?

Why Putty Cracks and Falls Out

1. The sash was not primed with oil or paint before it was glazed. When putty is applied to wood which has not been primed, the wood absorbs the oil from the putty, leaving the whiting with very little oil in it to hold it together. In a short time the putty crumbles and falls out.
2. Ice may have lifted the putty. In the winter when rain or snow melts on the window glass and runs down onto the putty, it is supposed to run off and do no damage. But if the water has a chance to get into cracks in the putty, or between the putty and the glass, it will freeze there and break the putty loose. Much of this may be prevented by the household mechanic by keeping the sash and putty well painted. When paint is applied to the putty it should extend up onto the glass about one-sixteenth of an inch. When paint is scraped from the outside of the glass it should not be scraped clear down to the putty. Enough should be left on the glass to prevent water from getting between the glass and the putty.
3. A poor grade of putty may have been used. This may be the case, but it is not likely. Putty is so cheap that even the best grade costs very little.
4. The sash may have rotted, leaving nothing for the putty to hold onto. This could have been prevented by keeping the sash well painted. If the sash has rotted, the only thing to do is to get a new sash.

JOB NO. 109

HOW TO REPLACE OLD PUTTY

Keeping the putty on the window sash is often one of the problems around the home. When the putty falls out there is no longer a weather-tight joint between the glass and the sash, and the wind and rain may come through. Replacing this putty so it will stay is a job for the household mechanic.

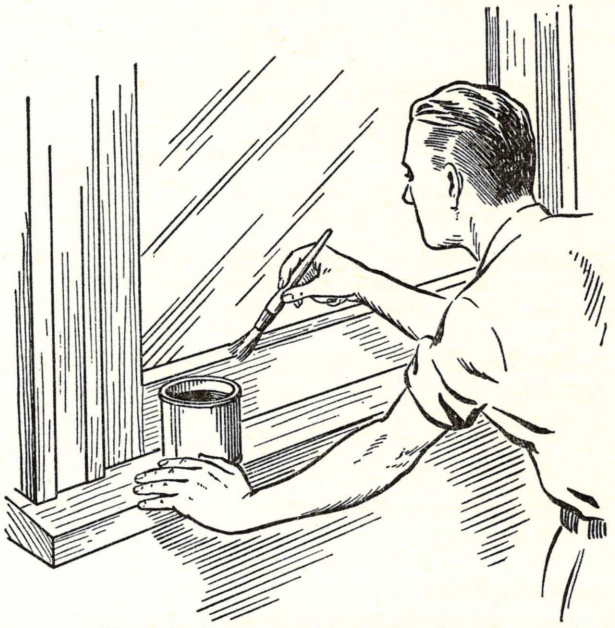


Fig. 487—Prime the dried out sash with linseed oil or thin paint

The Tools and Materials Necessary Are: A wood chisel, a putty knife, a small can of putty, a paint brush, and some thin paint or linseed oil.

Here Is a Good Plan for Doing the Job:

1. Clean out all of the loose putty and dirt with the wood chisel. The rebate should be scraped clean. Putty will not stick to dirty wood.
2. Prime the rebate of the sash with linseed oil or with paint the same color as the sash. The paint should be thinned with linseed oil so that it will soak into the pores of the wood. The oil will soak in better if it is allowed to dry a few hours before the putty is applied.
3. Apply the putty with a putty knife. Force the putty into all of the cracks, and bevel it off neatly. The putty should not extend out over the glass beyond the wood on the inside of the sash. (See Fig. 490.)
4. Allow the putty to set. Good putty will form a skin on the outside after a few days. The time

necessary for the putty to set depends upon the weather and the dryness of the wood.

5. Paint the entire sash, including the putty. The paint should extend onto the glass about one-sixteenth of an inch, to prevent water from getting under the putty. *Do not* scrape paint off the glass clear down to the bare putty. (See Painting, Job No. 38.)

JOB NO. 110

HOW TO REPLACE A BROKEN WINDOW PANE

Quite often, through accident, a window in the house or garage is broken. It is usually necessary to have it replaced at once, especially if the weather is bad. Glaziers cannot always be had immediately. The boy who breaks a window pane while playing ball, will find a knowledge of this job very much to his advantage, especially if he has to pay for a new glass out of his allowance.

The Necessary Materials Are Few and Inexpensive. They consist of thin paint or linseed oil for priming the sash, putty, glazier's points, and a pane of glass cut to fit the sash. These materials can be purchased at the hardware store.

Only a Few Tools Are Needed: A 1″ wood chisel for cleaning the sash and driving the glazier's points, a putty knife for applying the putty, and a brush for priming the sash will do very nicely. If the glass is to be cut, a straight edge and a glass cutter will also be needed.

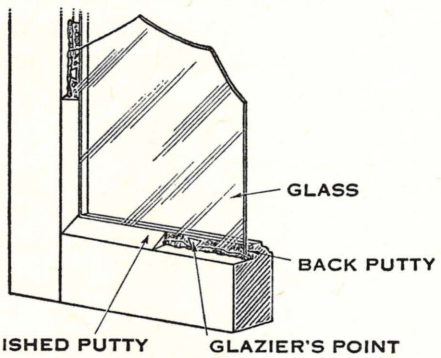


Fig. 488—A bed of putty is placed in the rebate of the sash. Then the glass is pressed firmly against this soft bed to make a tight joint

It Might Be Well to Follow the Plan of Work Given Below.

1. Remove the sash from the window frame if the window is on the second story. It is too dangerous to work on a ladder. The glazier places the sash on an easel, but the home repairman will likely find it more convenient to place the sash on a table top.
2. Remove the broken glass and clean out the dried putty with the wood chisel or the putty knife. Save the pieces of glass which may be large enough for another job. (See Fig. 490.)

Safety Measure: Wear gloves and goggles, and use pliers when removing broken glass.

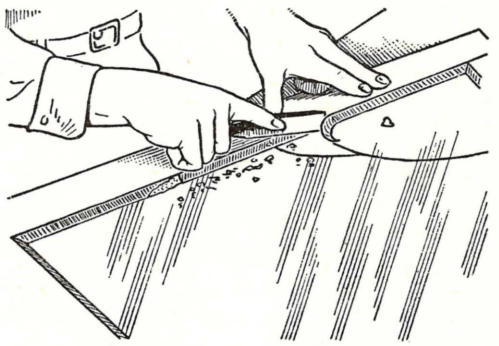


Fig. 489—The broken glass and old putty must be carefully removed from the sash

3. Prime the rebate of the sash with linseed oil or thin paint. This is done to prevent the wood from absorbing the oil from the putty.
4. Spread a thin layer of putty in the rebate of the sash. This is known as "back puttying." This seals the glass against the sash, making a weather-proof joint.
5. Place the glass in the sash. Be sure to check carefully at this point to make sure that the glass is lying absolutely flat. A piece of hard putty under one corner of the glass may cause it to break while being pressed into place.
6. Press the glass firmly into the sash until the putty oozes up around the edges. If the putty is soft, this task will be easy. Apply pressure as evenly as possible, as too much pressure may break the glass.
7. Fasten the glass in place with glazier's points. These should be about 6″ apart except in a very small sash.

Caution: Lay the glazier's points flat on the glass while driving them into the sash. Otherwise they may pinch the glass and break it. They should be driven far enough into the sash that they do not interfere with the worker while he is puttying.

8. After applying the putty smooth it out with the putty knife so it makes a neat, even bevel that does not extend beyond the rebate of the sash.
9. Clean the glass, both inside and out, with a soft paper or a dry cloth. Be careful not to disturb the fresh putty which will not harden for some time.
10. Paint the sash and putty after it has been allowed a few days to dry. (See Job No. 38.)

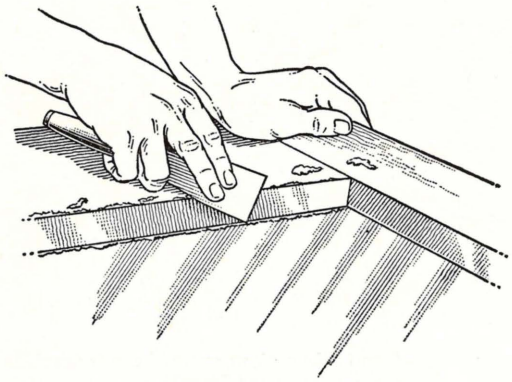


Fig. 490—The putty knife is used to make a neat, even bevel with the putty

Have You Done a Good Job? Ask yourself these questions.

1. Is the putty neatly beveled against the sash?
2. Has the sash been neatly back-puttied?
3. Are the glass and sash clean?

Caulking Around Doors and Windows

In masonry buildings there is often a loss of heat around window and door frames where the woodwork joins the masonry or siding. The household mechanic can stop these leaks by forcing caulking compound into the cracks. Caulking compound is a plastic material about the consistency of putty, but which never becomes brittle. Paint may be applied over it, which helps keep it soft.

When there is only a small amount of caulking to be done, it may be forced into the cracks with a wet knife. But this is a sticky, messy job. It is usually applied with a caulking gun. The hardware dealer usually has a gun which he loans with the purchase of caulking.

Window Screens

During summer months, ventilation is necessary. Windows cannot be left open because of insects, and because an open window provides no privacy. Window screens are a solution to this problem. The household mechanic is usually called upon to install and care for screens every season.

Screen, or Wire Cloth

Screen is usually made of very fine wire woven into a cloth, although recently a plastic screen has been placed on the market. The fineness of screen is designated by the size of the mesh or holes. For general purposes, 16-mesh is considered best. This means that there are sixteen holes per inch. Screen may also be purchased in 12, 14, and 18 mesh. The 12 mesh admits more light, but also admits more insects. Coarser wire cloth may be purchased in sizes from $\frac{1}{4}''$, called 4x4, up to $1''$, called 1x1. This is commonly used on doors in addition to the regular screen to prevent small children from pushing the regular screen out.

Fig. 491—Caulking should be forced into the cracks with a caulking gun

Screen is made in various widths to accomodate windows of different sizes, 18″ to 48″, in even inches.

Screens may be made of bronze, galvanized or enameled wire. Enameled screen is made of iron wire which has been enameled, usually black. Whenever the enamel wears or cracks off the screen should be painted. Otherwise the wire will rust. Galvanized screen is made of iron wire which has been coated with zinc. It stands the wear better than enameled screen, but should also be painted when it starts to rust. Bronze screen is the best grade, since it does not rust and does not require painting. The only objection is that it tarnishes. The rain washes the tarnish off onto the window sill and discolors it. The color of the screen changes to almost black. Do not polish the screen until it is bright again, as the same experience will be repeated. Bronze screen may be given a coat of clear lacquer or spar varnish while it is new. This preserves the color and prevents tarnishing.

Screen Frames

While some very excellent screen frames are made of metal, the household mechanic is mainly concerned with those made of wood. The construction of wood

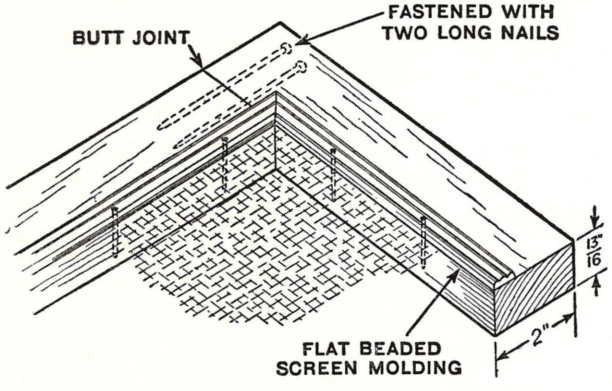


Fig. 492—Regular lumber with a butt joint is the simplest way to make a screen frame

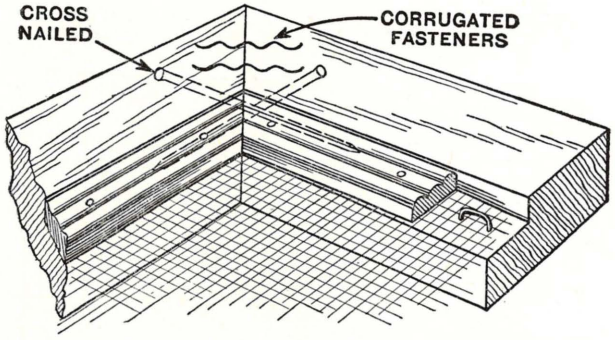


Fig. 493—Regular screen stock assembled with miter joints and held together with corrugated fasteners and nails make a strong frame

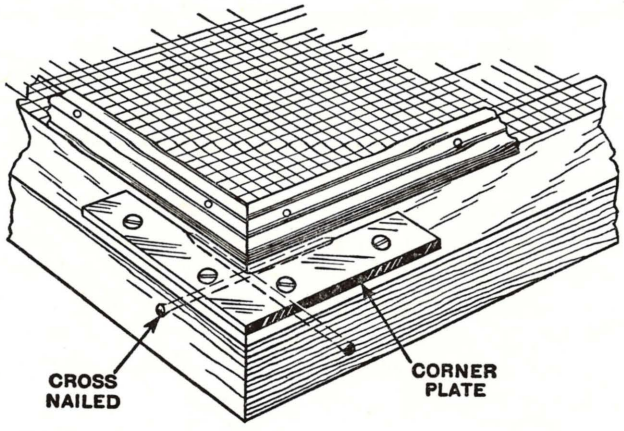


Fig. 494—Regular lumber reinforced with corner plates and fastened with nails is excellent

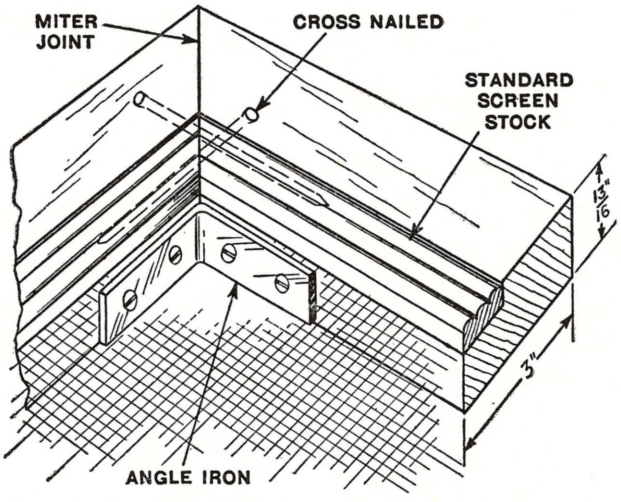


Fig. 495—Regular screen stock reinforced with an angle iron cross nailed makes a strong frame

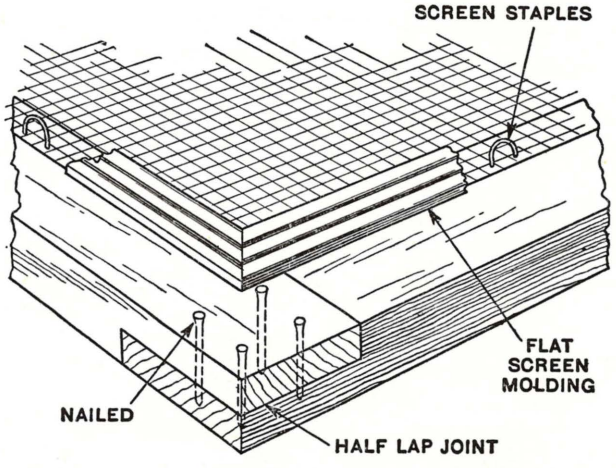


Fig. 496—Regular lumber made with a half lap joint makes a very good frame

frames varies considerably. Good screen frames may be made of ordinary $\frac{13}{16}$″ lumber. However, lumber yards sell regular screen stock which is much more convenient to use, and costs very little more. The frame may be put together with butt, miter, or half-lap joints. The miter or half-lap joints are recommended, but are more difficult to make. All screen frames, especially large frames need some kind of reinforcement since their construction is rather flimsy. Various kinds of hardware can be purchased for this purpose, or can be made by the household mechanic. The following illustrations show several types of construction.

JOB NO. 111

HOW TO MAKE A SMALL WINDOW SCREEN

The household mechanic can make his own window screens if he is willing carefully to plan his work. It is suggested that a small screen be attempted first.

Materials Necessary:

Go to a hardware store and get a piece of screen the proper width, and about 6″ longer than the frame. Nails, brads, staples and reinforcement hardware will also be necessary. Get from a lumber dealer, enough screenstock or flat lumber and screen molding to make the frame. Allow extra length for cutting.

Here Is a Good Plan to Follow. Remember, the work must be accurate.

1. Measure the window.
2. Cut the stock to length. Two vertical and two horizontal pieces will be necessary. Allow 1″ extra length on each piece for cutting.
3. Tack the two vertical pieces together, and the two horizontal pieces together with small nails. This is done so that they will be the same length when finished.

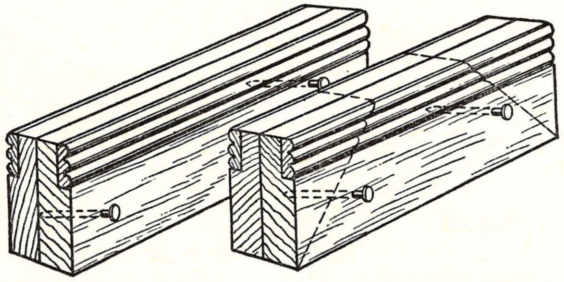


Fig. 497—Pieces of the same length may be tacked together for cutting the miter joint

4. Lay out and cut miter joints on all ends. Be sure to get the pieces long enough.
5. Assemble the pieces. The type of construction illustrated in Fig. 495(*c*) is recommended.
   (*a*) Nail all corners. Drive the nails so that they do not meet inside the wood.
   (*b*) Square each corner and install the hardware.

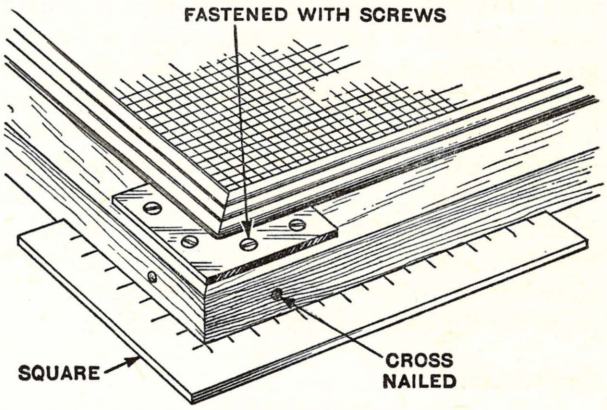


Fig. 498—Each corner is squared before the corner plates are fastened

6. Remove the strips of screen molding. This can be done by running a sharp knife along the partially cut seam.
7. Paint the screen frame at this time. Before the screen is installed, see Job No. 115.
8. Place the squared end of the screen in the rebate at the top of the screen frame. To be sure the screen is square, it should be cut all the way across along one wire. Be sure the edge of the screen lines up with the frame all the way to the bottom.
9. Fasten the top of the screen with screen staples. Use one to every four inches.

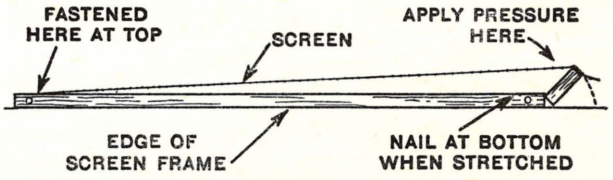


Fig. 499—Screen may be stretched by means of a block of wood nailed to the end of the screen

10. Stretch the screen and fasten the bottom. Getting the screen tight and even is a difficult task. Here is one suggestion. There are many others.

(*a*) Get a $\frac{3}{4}''$ board, 4″ wide, and as long as the width of the sash.

(*b*) Fasten the screen to the edge of the board so that the board cannot be laid flat against the bottom of the screen frame.

(*c*) Place the edge of the board at the bottom of the screen frame.

(*d*) Press down on the board and fasten the end of the screen in the rabbet at the bottom of the screen frame while the screen is still tight.

11. Cut off the end of the screen with a pair of tin snips or an old knife.
12. Fasten the screen molding in place with $\frac{5}{8}''$ brads.
13. Test the screen by installing it in the window frame. If it is necessary to plane the edge, the nails at the corners should be set so as not to nick the plane blade. (See Nailing, page 6.)

The Care of Screens

Putting the screens up in the spring and taking them down again in the fall are a part of the household mechanics regular duties. It is then that most of the work must be done on screens. The following jobs cover most ordinary situations.

JOB NO. 112

INSPECT WINDOW SCREENS

Screens should be cleaned before they are put up in the spring. Dust, dirt, and possibly rust has accumulated during the winter. This would get on the window glass when it rains, or would be blown into the house when the windows are open. Autumn is also a good time to find out the condition of the screens, and to do the repair work necessary.

Materials Necessary:

Usually the garden hose and the broom are all that is necessary.

Here Is an Orderly Plan to Follow:

1. Wash off the screen with the hose and broom. It will be necessary to wash both sides.
2. Inspect the screen for rust. If rust is beginning to form, the screen should be repainted. (See: How To Paint Screens, page 178.)
3. Inspect the screen for holes. If the holes are too large, the screen will have to be replaced. Otherwise the holes should be patched. (See: How To Patch Holes In Screen, Job No. 113.)
4. Inspect the screen frame for condition of paint, loose joints, rotten wood, etc. Repair work may be necessary.
5. Inspect the hardware. New hangers or hooks may be needed.
6. Do any of the repair work necessary.

JOB NO. 113

HOW TO PATCH HOLES IN SCREEN

When a screen has a hole in it, insects find their way through the hole and enter the house. If the hole is not too large, it may be repaired. If the hole is large, the entire screen should be replaced.

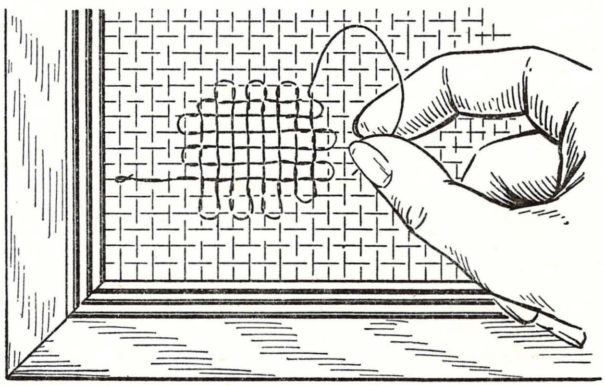


Fig. 500—A hole in a screen may be patched by weaving screen wire through it

Materials Needed:

A piece of wire unraveled from the edge of a piece of screen, or a patch about 1″ larger than the hole, made from another piece of screen, and a pair of tin snips.

Here Are Two Plans for Patching Screen. Select the one best suited.

Plan A. For holes less than $\frac{3}{4}''$ in diameter.

1. Straighten a piece of screen wire by drawing it over a pipe or other round object.
2. Starting about two meshes to one side of the hole, weave the wire back and forth across the hole and about two meshes past the hole each way.
3. Repeat the operation vertically, until the hole is covered, and the wire is woven two meshes past the hole.
4. Cut off the loose ends.

Plan B. When the hole is larger than $\frac{3}{4}$".

1. Cut a square patch out of another piece of screen, about 1" larger than the hole.
2. Cut off each corner a distance of three squares each way.

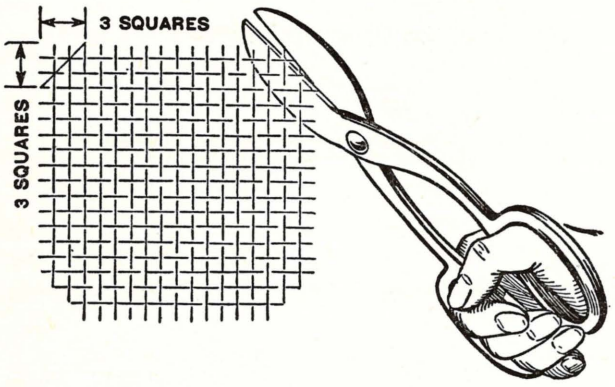


Fig. 501—A patch may be cut from another piece of screen

3. Remove the outside wire from each side of the patch.
4. Bend the ends of the wires all at right angles to the patch.
5. Place the patch over the hole.
6. Push the ends through the screen.
7. Clinch or flatten the ends of the wires from the other side of the screen. The patch will then hold itself in place.

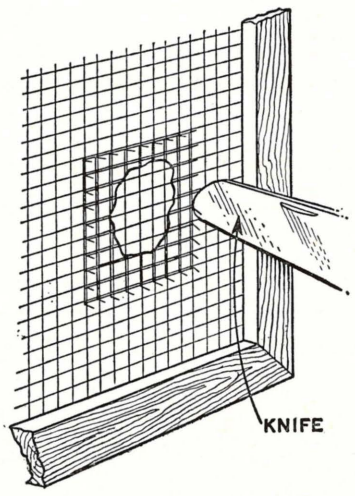


Fig. 502—The patch holds itself in place when the prongs are clinched

JOB NO. 114

HOW TO PAINT WINDOW SCREENS

Paint is very important in making window screens last longer. Freshly painted screens also add to the general appearance of the house. Painting screens is a job made to order for the household mechanic.

Materials Needed:

Get a can of regular screen paint from the hardware store. If the frame is to be a different color, another can of paint will be necessary. A paint brush will be needed to paint the frames, and possibly a screwdriver to remove the molding. A special screen painting tool will be needed for the screen. This should be made by the household mechanic as follows:

(*a*) Cut a block of wood, $\frac{3}{4}$"x2"x6".

(*b*) Nail a piece of carpet to the block as illustrated.

The purpose of this tool is to enable the household mechanic to paint the screen without filling the holes with paint. This is very difficult with the ordinary paint brush. After this tool has been used, it may be cleaned with turpentine, or it may be thrown away and a new one made for the next job.

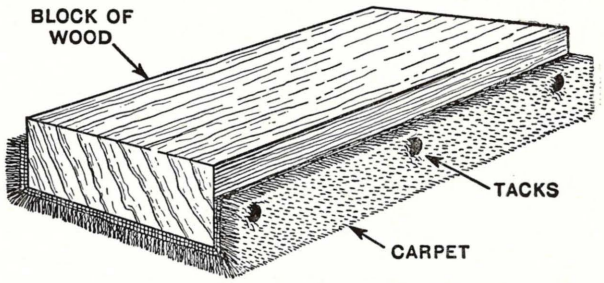


Fig. 503—A screen painting tool may be made from a piece of carpet tacked to a block of wood

Follow This Plan in Doing the Job:

1. Clean all rust off the screen, and all loose paint off the frames. Paint will not stick to rusty metal. Paint applied to loose paint will peel off.
2. Fill cracks and nail holes in frame with putty. (Putty made from the paste at the bottom of the can of paint is best. See page 46.)
3. If the frame is to be painted a different color than the screen, remove the molding with the screwdriver. Be careful not to split it.
4. Moisten the carpet of the screen painting tool with screen paint. Do not dip the block into the paint.

5. Apply screen paint to the screen with the screen painting tool. Brush it out until the holes are free of paint. Turn the screen over and do the same area on the other side before finishing the first side. Try not to smear the frame unless it is to be the same color as the screen.

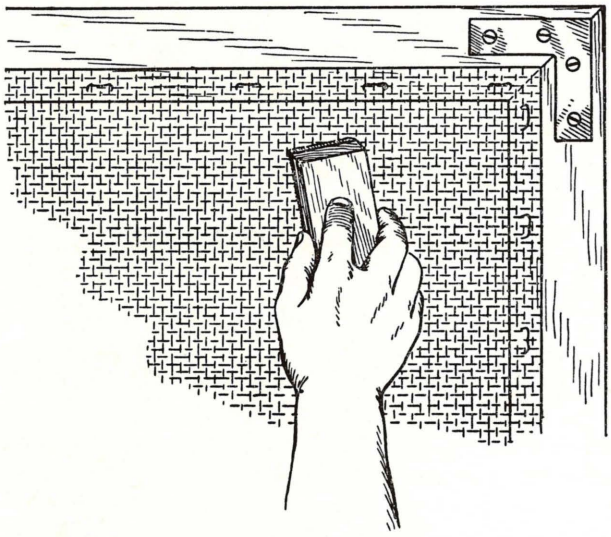


Fig. 504—The screen painting tool makes screen painting easy

6. Replace the molding.
7. Paint the molding and the frame with a regular paint brush.
8. Care for the paint and paint brush.
9. Allow the paint on the screen at least 24 hours to dry.

JOB NO. 115

STORE SCREENS FOR THE WINTER

A good place to store screens in the winter goes a long way toward making them last longer. If they are carelessly strewn about the basement or garage they are apt to become broken or warped out of shape. The household mechanic should make some provision to keep screens clean and out of danger. The same rack used for screens in winter can be used for storm windows in summer.

Plan 1.

Screens may be stacked in a level pile in the attic of the house or garage. Be sure they are level and are piled so that they are all flat. Take care that hooks and other hardware do not make holes in the screen. The pile should be covered with canvas or cardboard to keep the dust and dirt out, and to protect the screen from falling objects. Do not permit other objects to be placed on top of the pile.

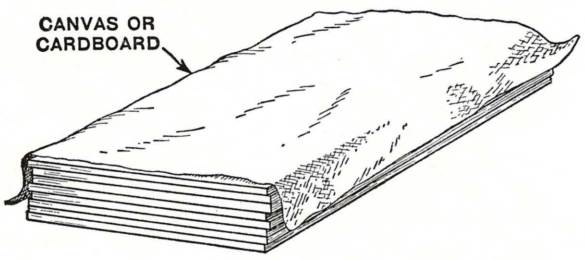


Fig. 505—Screens may be piled flat in a dry place if they are kept covered and clear of "junk"

Plan 2.

Build a rack from the floor joists in the ceiling of the basement or garage. The screens may then be kept out of the way so they will not become damaged.

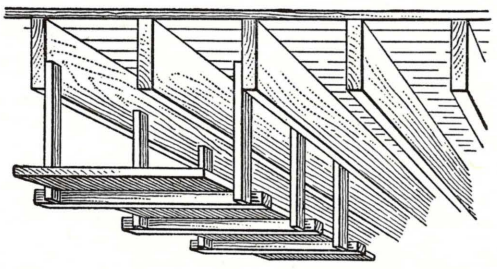


Fig. 506—A storage rack for screens should be built in the garage, attic, or basement

Plan 3.

The most elaborate arrangement is to build a filing case for the screens in the attic of the garage or house. By this method, the screens may be labeled, and any screen may be removed without disturbing the others.

Screens should be numbered, and duplicate numbers attached to the window sill. This will assist in locating the screen for each opening.

Storm Windows

During the winter months windows need extra protection against the cold. Frost forms on the glass on cold days. As the house warms up, this melts and runs down onto the window sill, spoiling the paint. There is also a great amount of heat lost through the glass. Storm windows are used to prevent this. When storm windows are used, a dead air space is created between the storm window and the regular window. This acts as an insulation. If the storm window fits properly there will be no frost on the window. The heating bill will be much less if storm windows are used.

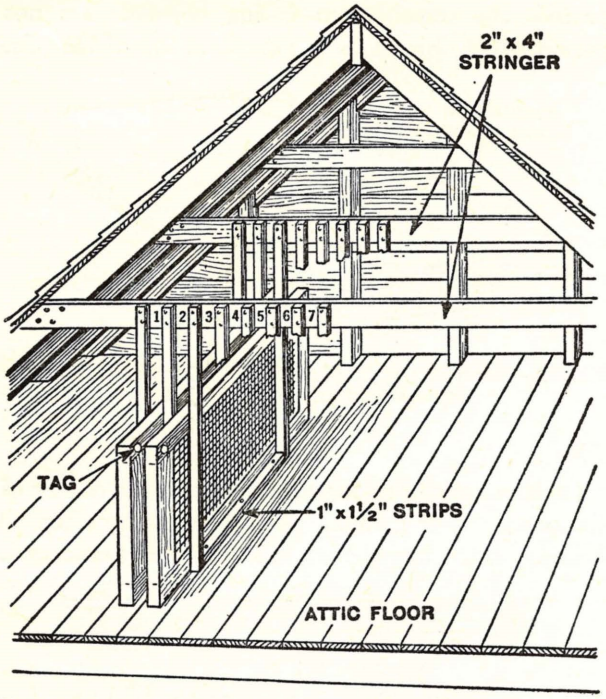


Fig. 507—A filing rack for screens can be built in the attic of the garage or house

The Care of Storm Windows

Storm windows require about the same care as ordinary windows and screens. They are installed in the fall when the screens are removed. In the

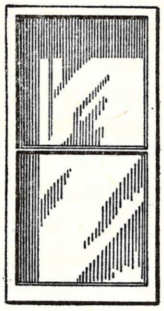


Fig. 508—Storm sash greatly reduce the cost of heating the home

spring they should be removed, repaired and painted if necessary before they are stored for the summer. They can be stored in the same place used for screens in the winter. Painting, replacing glass or replacing putty can be done in exactly the same manner as for the regular window.

Steel Casement Windows

A casement window is, as we have said before, a window which is hung on hinges. In modern houses, casement windows are usually made of steel. In recent years steel casement windows have become very popular for homes. Practically all basement windows are steel casements.

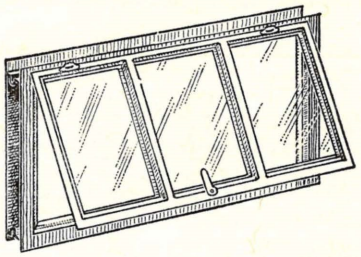


Fig. 509—The steel casement basement window

The manufacturers of steel casement windows claim several advantages over wood windows. In the first place, there is better ventilation control. The hinged windows extend out beyond the house when they are open, and catch any breeze which may be blowing. In the second place, steel casement windows admit more light. The stiles and rails are not as wide as in wood windows. Little or no casing is required because no springs or weight pockets are necessary. The space thus saved may be devoted to more wall space or larger windows. In the third place, steel windows are easy to operate. Steel does not swell during damp weather and cause windows to stick. In the fourth place, steel windows have either metal or stone sills. Water which runs down off the inside of a window during cold weather does not harm these sills. On wood sills, the water soon ruins the paint. In the fifth place, both the inside and outside of the window may be washed from the inside of the house. This eliminates dangerous climbing on ladders. In the sixth place, screens and storm windows are made for these windows which require no fitting. They are installed from the inside of the house, and can be put up or taken down easily.

A few disadvantages of the steel casement window have been pointed out. First, because of the cold steel, there is more condensation of moisture on the glass during cold weather, and, of course, more water runs off onto the window sill. This can be corrected if storm windows are used. In the second place, it has been pointed out that the complete units including screens and storm windows are more expensive than wood windows. This is questionable, however, when the amount of light admitted is considered.

Fig. 510—Steel casement windows are easy to clean

The Care of Steel Casement Windows

Much of the care of steel casement windows is the same as for wood windows. The following will serve as a check list of things to be done.

1. **Painting.** Steel casements need painting the same as wood windows. Paint made especially for metal should be used.
2. **Replacing Glass.** Metal casements are glazed in much the same manner as wood sash. Metal clips are used instead of glazier's points. It is best to use putty made especially for steel casements.
3. **Lubricating.** Steel casements have mechanical parts which need lubricating occasionally. Oil or vaseline is used for this purpose.
4. **Caulking.** It is necessary to replace the caulking between the casement and the brick or stone work occasionally. This is done in the same manner as for wood casings.

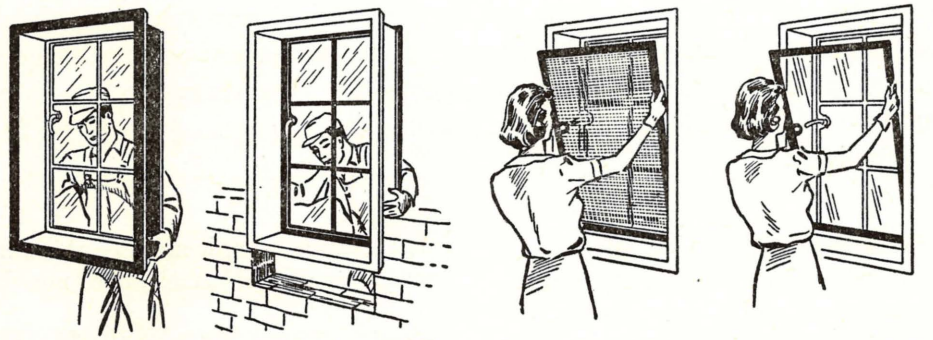


Fig. 511—The steel casement window is installed as a complete unit

Using Concrete, Mortar, and Plaster

Chapter 8

CONCRETE

CONCRETE is made by mixing portland cement, sand, coarse gravel or crushed stone, and water. Portland cement is made of several kinds of stone burned and ground together into a fine powder which hardens when it becomes wet. It is sold in 94 lb. sacks and must be stored in a dry place. The proportions of cement, sand, and gravel used in concrete depend upon the kind of work to be done. In some kinds of work, coarse gravel

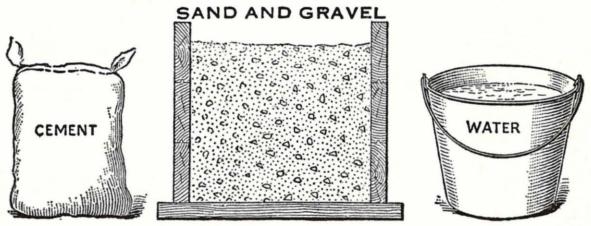


Fig. 512—Materials in concrete

or crushed stone are left out entirely. Gravel, as it is taken from the pit, is a mixture of sand and stones. But the proportions of sand and stones is not always right to make the kind of concrete desired. For this reason, pit gravel is often screened and mixed again in the proper proportion of sand and stone. Either sand or stone may be purchased by the cubic yard, to be mixed on the job in the proper proportion. However, good clean gravel, which contains about two parts sand and four parts stones smaller than $\frac{3}{4}''$, will be found satisfactory for most purposes.

How To Make Good Concrete

The strength, durability, and the ability of concrete to hold or keep out water depend upon the proportions of cement, water, and gravel (sand and pebbles) used. The proportions vary according to the job. A concrete water-tank would need a richer mixture of cement and sand than would a concrete sidewalk. The proper amount of water is more important than most people think. Less water is needed when the sand and pebbles are wet than when they are dry. When they are dry, about six gallons of water should be used for each sack of cement when mixing concrete for sidewalks. If the sand and gravel are wet, only about five gallons of water are needed. In a good mixture, there is enough cement and sand to fill in the spaces between the coarser gravel. Enough water must be used to carry the cement and sand in between the coarser stones. The mixture should be thin enough to fill the form completely without leaving air pockets. At the same time, it must be thick enough that the richer mixture of cement does not float to the top.

Clean Materials Must Be Used

For all kinds of work, the water used must be clean. Stale water from ponds or marshes should not be used. The gravel used should also be clean. It must not have a high percentage of dirt, clay, or silt. Pit sand and gravel are best because the particles are sharp. Beach sand is not usually satisfactory because the sand may contain salt and fine particles. Real fine sand, or quicksand, separate from the cement and settle to the bottom. Poor quality sand is apt to have quicksand in it. The household mechanic can test the sand or gravel to be used for dirt or silt content. Place sbout one inch of sand in a glass of water, and stir it up well. Then let it settle for a while. If the water on top of the sand is slightly cloudy, there is probably not enough dirt to do any harm. But if it

remains muddy, or a thick film of dirt settles on top of the sand, there is too much dirt in it to use.

Materials for Sidewalks

Since the household mechanic will be called upon to build or repair sidewalks more often than any other type of work, information will be given for that type of work. A 1-2-3 mixture is considered

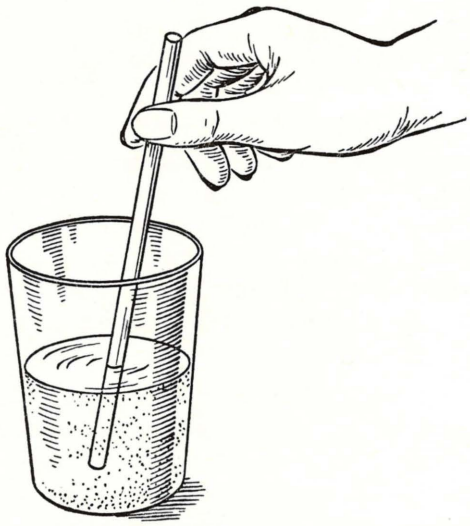


Fig. 513—To test the sand for dirt content, place about an inch of sand in a half glass of water and stir well

best for sidewalks. This means one part of cement, two parts of sand, and three parts of coarse gravel. Many people call it a one, two, three mixture. Sometimes it is called a one five mixture because the sand and gravel are often purchased already mixed.

Fig. 514—If the water remains cloudy, it probably does not contain enough dirt to do any harm

Ordering Materials for Sidewalks

The following table can be used to figure the amount of materials needed. Before figuring, find out the dimensions of the piece of sidewalk to be repaired. Sometimes gravel may be purchased by the sack instead of by the yard. One sack is equal to about $\frac{1}{25}$ of a cubic yard.

If the block of sidewalk to be repaired is 3 feet

Sacks of Cement	The Amount of Sand and Gravel	Will Pour this Number Sq. Ft. of 5″ Sidewalk
1	5 sacks or $\frac{1}{5}$ cu. yd.	9
2	10 sacks or $\frac{2}{5}$ cu. yd.	18
3	15 sacks or $\frac{3}{5}$ cu. yd.	27
4	20 sacks or $\frac{4}{5}$ cu. yd.	37
5	25 sacks or 1 cu. yd.	46

square, materials should be figured for 9 square feet. According to the chart, 1 sack of cement, and 5 sacks or $\frac{1}{5}$ cu. yd. of gravel will pour 9 square feet of five-inch sidewalk. There may be a small amount of concrete left over, as it is almost impossible to mix exactly the right amount, and there must be enough prepared.

How to Mix Concrete

The household mechanic will usually be required to mix concrete by hand. Concrete can be mixed

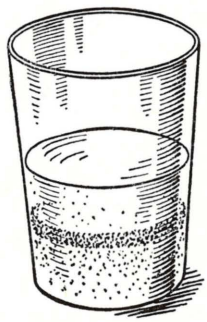


Fig. 515—If the water remains muddy, and a thick film of dirt settles on top of the sand, it contains too much dirt to use

on an adjoining section of sidewalk, or on the garage floor if care is used to wash it off before the cement dries on it. A wooden platform is often constructed. The dry materials should be well mixed by turning the cement and sand over and over with a hoe or shovel. Then a depression is made in the center and the proper amount of water poured in. The sand, cement and water are mixed until the entire amount is well mixed. Concrete should be used within thirty minutes after it is mixed. It should be stirred every few minutes to prevent it from setting.

How to Cure Concrete

Freshly-poured concrete should not be permitted to dry out. It should be protected from the sun and wind for a week or ten days after pouring. Otherwise the water which is necessary for proper hardening will evaporate. Sidewalks should be covered with straw or canvas and sprinkled as soon as the concrete has hardened enough that the finish will not be injured. This should be done for about

ten days after pouring. In cold weather, the concrete must be kept from freezing, but does not require wetting down.

Reinforcing Concrete

Steel rods or wire mesh are often used to reinforce concrete. It adds strength to the concrete. Driveways and other broad surfaces should be reinforced. Larger concrete projects, such as walls and bridges are always reinforced. A concrete porch slab is apt to crack due to the action of the frost if it is not reinforced. Sidewalks, are not usually reinforced, but would probably last much longer if they were, especially if laid on soft ground.

Here Are a Few Questions to Test Your Knowledge of Concrete.

1. What is portland cement?
2. What is concrete?
3. What is gravel?
4. Why is beach sand usually not satisfactory for concrete?
5. Why is pit gravel best for concrete?
6. What is meant by a 1, 2, 3 mixture?
7. Does concrete cure best when it is wet, or dry?
8. For pouring sidewalks, how many gallons of water are required for each bag of cement, if the gravel is dry?
9. How soon should concrete be used after it is mixed?
10. In order to make good concrete, it is necessary to have enough fine sand and cement to _____ _____ around the larger pieces of gravel.

JOB NO. 116

HOW TO REPAIR A CONCRETE SIDEWALK

Concrete sidewalks are broken from time to time. Cracks appear in the surface because of poor construction, frost, or too heavy a load. The home repairman can make these repairs. He should be very careful, however, to do it right in order that his labors be not wasted. Generally speaking the entire broken section must be replaced.

Materials Needed:

Lumber will be needed for the forms. Good clean pieces of 2″×4″ should be used.

The proper amount of cement, sand, and coarse gravel will be necessary. Always purchase a good grade of gravel.

Equipment Needed:

A square shovel, a mixing board, a straight edge about 4 feet long, and a trowel are the most important tools.

Here Is a Plan for Repairing a Concrete Sidewalk. Be very sure to follow instructions carefully.

1. Remove the entire broken section of the sidewalk. Just filling in a part of a section makes a patchy looking job. Be very careful not to break the edges of the good sidewalk.
2. Prepare the bed for the concrete. The bed should be firm and well drained. If it is wet or soggy, a bed of cinders or coarse gravel about 8″ or 10″ deep should be tamped solid and leveled about 5″ below the rest of the sidewalk. The old sidewalk broken into fine pieces may be used.
3. Construct the forms. The forms should be placed so that they are the same height as the old sidewalk. No joints in the forms should occur in the sections to be repaired. Be sure the forms are solid. Much work is spoiled by poor forms.
4. Mix only enough concrete for one section at a time. Each section should be poured separately, so that a cushion can be placed between to allow for expansion. This also prevents laps in the center of a section.

   Turn the dry mixture enough so that the cement is well mixed with the sand and gravel before adding the water. Add just enough water to make the mixture work easily, but not enough to make it flow like liquid.
5. Pour the concrete for one section. The forms should be filled up to the level of the old sidewalk.
6. Level the surface. This can be done best by drawing a straight edged board across the top of the forms, lengthwise of the walk. The walk should be slightly higher in the center than at the sides to provide drainage.

   If two adjoining sections are to be repaired, the scantling across the end of the first section should be removed when the concrete in the first section has "set." A strip of tar paper should then be placed flat against the first section and the second section poured.
7. Trowel the surface when the concrete begins to set. Best results may be had by troweling

with a wooden float. This produces a slightly rough surface instead of a very smooth surface. The edges all the way around the sidewalk should be slightly beveled.

8. Cover the sidewalk. This is done to protect it from the sun, wind, dirt, and traffic. Building paper held in place by boards, is very good for this purpose. It should remain covered for three or four days. The surface should be sprinkled with water occasionally to keep it from drying out too rapidly.

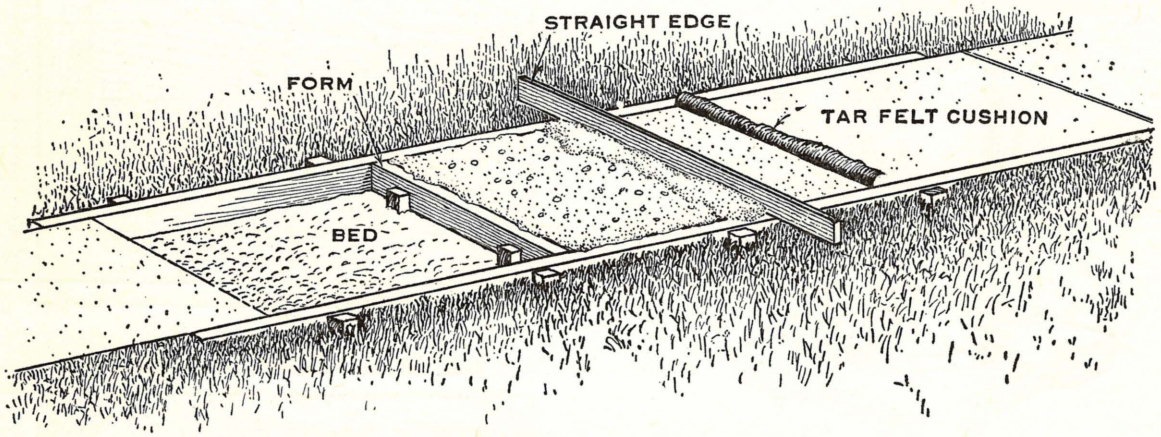


Fig. 516—Replacing a broken section of sidewalk

9. Remove the forms. The soil may be tamped in place along the sides of the new section of sidewalk.

Is the Completed Job Satisfactory? These questions may help you check your work.

1. Is the repaired section the same width and height as the remainder of the sidewalk?
2. Is the surface level?
3. Are the edges neatly beveled all the way around?
4. How long should concrete cure before it is used?
5. Should concrete be kept wet or dry while setting?

JOB NO. 117

HOW TO MAKE A CONCRETE TEAPOT STAND

A concrete stand for the teapot or coffee pot is a very practical thing to have in the house. Heat from the teapot or coffee pot is likely to spoil the finish on the table. A teapot stand is quite easy to make.

The Following Equipment Is Necessary:

A small trowel for mixing the concrete, and a piece of wood for tamping.

The Following Materials are Necessary:

One cupful of cement and two cupfuls of sand are enough for this sized teapot stand. If a larger one is made, more will be needed. No coarse gravel or stone should be used.

A form will be necessary. One made out of $\frac{1}{2}''$ white pine is suggested.

A piece of wire screen, the same shape as the top of the teapot stand and about $\frac{1}{2}''$ smaller, is needed for reinforcement.

Here Is a Good Way to Make the Teapot Stand. Be sure to follow instructions carefully.

1. Construct the form to be used. The design shown is suggested (see Fig. 517), but any other desired shape can be used. The surfaces on the inside of the form should be smooth.
2. Mix sand and cement thoroughly in the dry form. The proper mixture for this job is 1:2. Special cement coloring may be added if desired.
3. Sprinkle the water on gradually and mix thoroughly. Do not use too much water, as this floats the cement to the top.
4. Wet the forms with water. This helps to keep the cement from sticking to the forms.
5. Pour concrete into the form until it is about half full; then tamp lightly.
6. Lay wire reinforcement in the form. Press it down into the concrete, but do not allow it to touch the form at any point. (See Fig. 519.)
7. Pour the remainder of the concrete into the form.
8. Smooth even with the top of the form. Draw a straight edge stick across the top of the form to level the concrete.

9. Allow the concrete to stand for a few minutes; then trowel the surface. This brings a coating of cement to the surface.
10. Cover the entire form with a wet cloth and allow the cement to set.
11. Remove the forms after 24 hours. Place the teapot stand in water for four or five days. Concrete will be much harder if kept wet while setting.

Fig. 517—Teapot stand

12. Remove the stand from the water and allow it to dry thoroughly.
13. Decorate as desired. The surface may be washed with a solution of cement and water which produces a very smooth finish. It may also be painted.

Are You Pleased With the Job You Have Done? Here are some questions which may help you decide how well you have done it.

1. Are there any chipped corners?
2. Are there any pits or crumbly places on the surface?
3. Is the finish good?

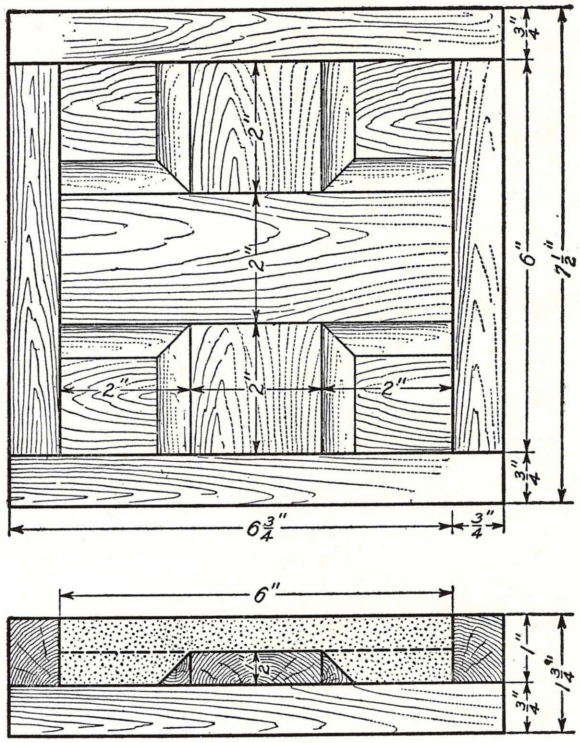


Fig. 518—The 'form' for molding a teapot stand

4. Why are reinforcements used in concrete work?
5. Will concrete cure harder in the sun, or in the shade?

SUGGESTED JOBS

Here are some other jobs which can be done at this time if desired. The procedure is the same, but different forms will have to be made.

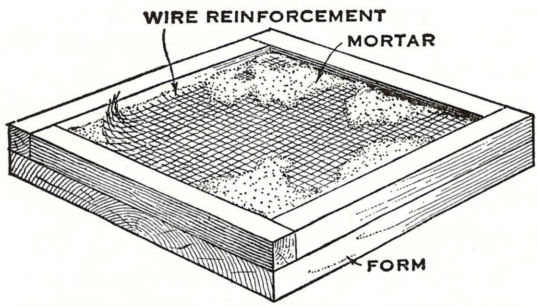


Fig. 519—Placing the wire reinforcement in a half-filled form

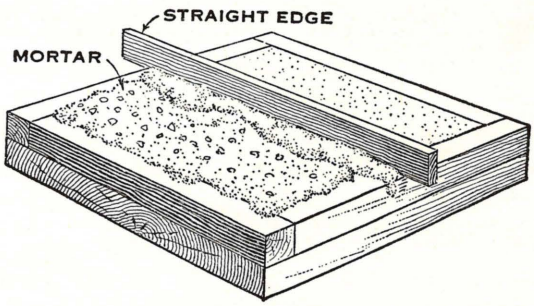


Fig. 520—Leveling concrete with a straight edge

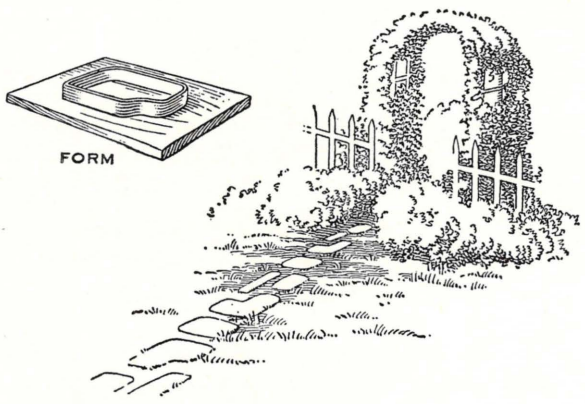


Fig. 521—Concrete flags for the garden path

JOB NO. 118

CONCRETE FLAGS FOR THE GARDEN PATH

Various shaped concrete flags, artistically placed, make an interesting and attractive garden path. Study the illustration to get a general idea of the construction of the form and the results to be obtained.

JOB NO. 119

A CONCRETE PAPER WEIGHT

Here is an opportunity to make an object that Dad will find very useful at his office or on his desk at home. The variety of designs that can be made is unlimited.

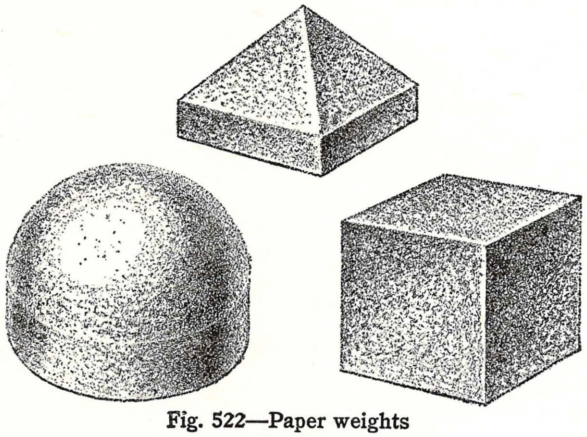


Fig. 522—Paper weights

MORTAR

Mortar is made by mixing sand, lime and water. It is used to bind brick or stone together into a solid mass. Lime used in making mortar must be put through a process known as "slaking." This is does by adding water to the dry lime and allowing it to stand until it stops boiling, and forms a smooth stiff paste. Directions for slaking lime will always be found on the sack. Lime may be purchased in sacks or barrels. Hydrated lime, which is lime already slaked, may be purchased. When a stronger mortar is needed, portland cement is added to the dry sand before mixing with the lime paste. For the strongest mortar portland cement with 10% hydrated lime is used.

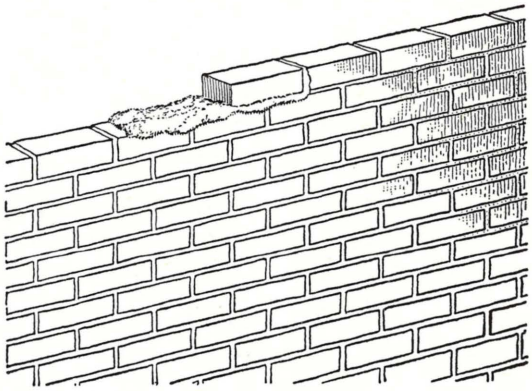


Fig. 523—Mortar holds brick or stone together in a wall

The household mechanic will do well to buy especially-prepared mortar for repair work. Professional bricklayers use it instead of preparing their own lime mortar. Simply mix sand and water with it, and the mortar is ready for use. Proportions and directions will be found on the sack.

JOB NO. 120

HOW TO REPOINT A BRICK WALL

Often the mortar between the bricks in a wall or a chimney crumbles, and the bricks become loose. This not only spoils the appearance of the wall, but weakens it as well. If the crumbling is allowed to continue, the whole wall will have to be rebuilt. The home repairman can save this expense if he is willing to learn a little about the process known as repointing. This means filling the spaces between the bricks with new mortar, and resetting the bricks in mortar if necessary.

Necessary Materials:

Sand and lime will be needed for the mortar. Cement may be added if an especially strong mortar is needed. Mortar coloring to match the color of the mortar in the rest of the wall should be used. Sometimes it will be necessary to use new brick. These should be the same as those in the rest of the wall if possible.

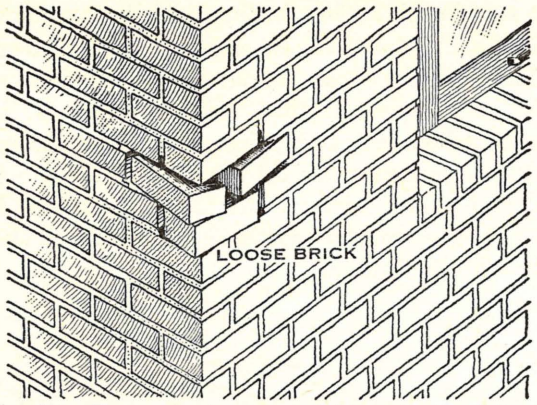


Fig. 524—The mortar joints in a brick wall often fall out

Necessary Equipment:

A trowel and a mixing board will be needed for mixing and working the mortar. A mixing box will be necessary for slaking the lime for the mortar.

Here Is a Plan for Repointing a Brick Wall. These directions are important. Read them carefully.

1. Slake the lime for the mortar. This is done by placing the lime in a box and adding water. It is best to follow the directions given on the sack as some brands of lime require a treatment different from others. Hydrated lime, which is already slaked, may be purchased.
2. Clean all of the old loose mortar from between the bricks. It is useless to try to make the mortar stick to old mortar which is loose and crumbly. If bricks are loose, they should be removed and cleaned.
3. Mix the mortar. Sand should be added to the slaked lime paste. Portland cement may be mixed with the dry sand if an especially strong mortar is desired. Add the water necessary to make the mortar spread easily.
4. Wet the bricks and mortar in the wall. This is done to prevent the dry bricks from absorbing too much moisture from the mortar. If the mortar dries too rapidly it will crumble.
5. Fill in the joints. The mortar should be put in place with the trowel. The joints should be finished the same as those in the remainder of the wall.

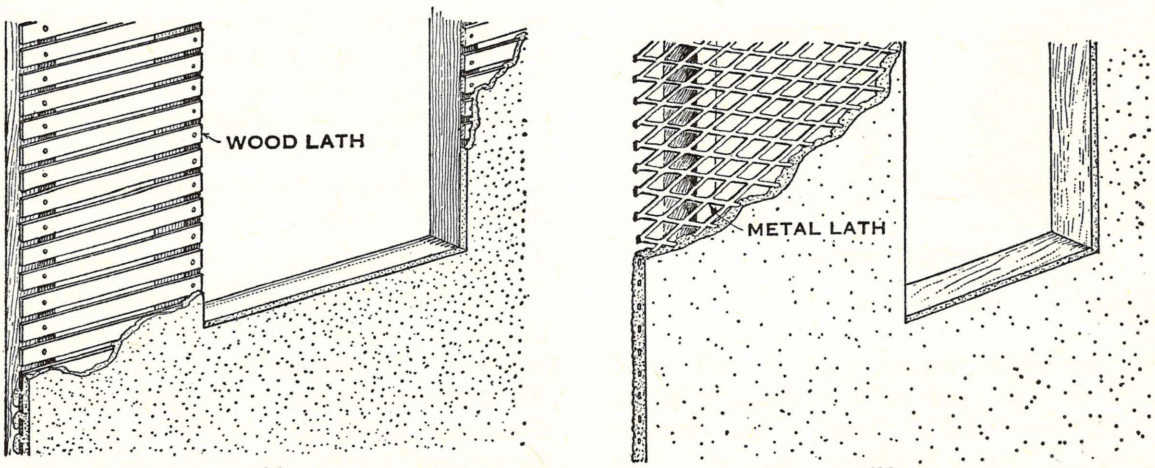
   When replacing loose bricks, or putting in new bricks, be sure to follow the same pattern, or bond, as used in the rest of the wall.
6. Clean the completed work and the equipment. Mortar left to dry on tools is difficult to remove.

How does the Completed Job Look? These questions may help you decide how well you have done the work.

1. Is the mortar smeared over the adjoining brick work?
2. Is the bond the same as that in the rest of the wall?
3. Does the mortar joint match the rest of the brick work?
4. What is contained in mortar which is not contained in concrete?
5. Why should bricks be wet when laid?

PLASTER

Plaster is commonly used as a covering for the inside walls of houses. It is applied to a support of wood or metal lath which has been fastened to the framework of the house. As the plaster is applied to the face of the lath, some of the plaster is



(*a*) (*b*)

Fig. 525 (*a*) and (*b*)—Plaster is applied on wood or metal lath

forced through the spaces between the lath, forming a key which holds the plaster in place. Without this key, the plaster would not stick well. There are many kinds of plaster. Rough inside plaster usually contains lime, sand, hair, and water. The hair helps to hold the plaster together. Finish plaster usually contains plaster of Paris, lime, sand and water. Plaster used on the outside of buildings is known as stucco. The home repairman should use specially prepared patching plaster for repair work around the home. Plaster of Paris is sometimes found to be convenient, especially for small holes. Gypsum plaster, or patent plaster may be used.

JOB NO. 121

HOW TO PATCH A HOLE IN A PLASTERED WALL

Cracks or holes in a plastered wall do not have a very pleasing appearance. Furthermore, they will get larger if not repaired. The home mechanic can repair such places. He must, however, follow

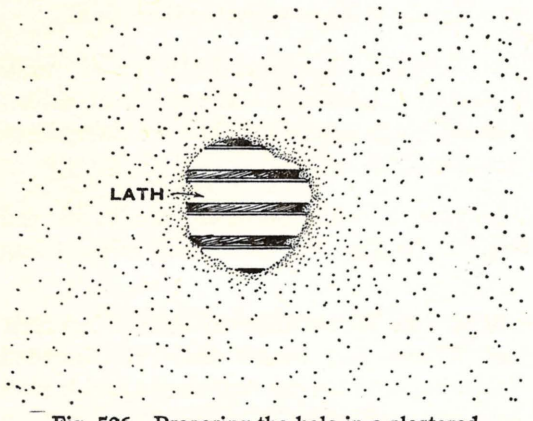


Fig. 526—Preparing the hole in a plastered wall for patching

directions carefully, and use good judgment in planning the job. Large areas of loose or fallen plaster should be replaced by a tradesman who has the proper equipment and understands his job.

Materials Needed:

Ready-mixed patching plaster is the best thing to use. It is not worth while to mix ordinary plaster for a small job.

Equipment Needed:

A tin pan is a good utensil to hold the plaster while mixing. A putty knife or kitchen knife will be needed for filling up the hole or crack.

Here Is a Plan for Repairing Cracks and Small Holes in a Plastered Wall.

1. Remove all loose plaster. It is useless to try to repair a hole in loose plaster. A putty knife is a very handy tool to use in removing loose plaster.
2. Dampen the lath and ragged edges of the plaster around the hole. This is done to prevent the old plaster and laths from absorbing the moisture from the patching plaster.
3. Mix the patching plaster. Use the directions given on the box.

   Caution: Work fast. Patching plaster dries quickly. If much patching is to be done, mix only small amounts at a time.
4. Fill the holes or cracks. Use the putty knife for filling the holes.
5. Smooth the plaster even with the remainder of the wall. The surface may be smoothed with a smooth piece of board, longer than the diameter of the hole. Moisten the patch and repeatedly smooth with the board to get a smooth even finish. The finish should match the rest of the wall if possible.
6. Allow the patch to dry for several days. Repaired patches should not be painted until thoroughly dry. Then they should be given a coat of thin varnish or shellac before paint is applied.

Did You Do a Good Job? These questions will help you to check your work.

1. Is the patch even with the rest of the wall?
2. Is the surface of the patch smooth?
3. Why should the patch be given a coat of shellac or varnish before it is painted?
4. Why should the edges of the hole be dampened before applying the plaster?
5. Why not mix regular plaster to patch a small hole in the wall?

Using Rope and Twine

Chapter 9

KNOTS AND SPLICES

THE ability to tie knots in twine or rope is valuable to a person in any walk of life. The Boy Scout is required to be familiar with a few types of knots. There are many trades and vocations in which the ability to tie a safe knot is very important. The sailor of former days used rope a great deal, hence much of our knowledge of rope comes from the sailor. Our study will be confined to just a few of the knots and splices which will be found most useful to the average person.

Here Is Some Information About Rope Which Every Person Should Have. Study It Carefully.

Rope is made of vegetable fibers. Manila hemp, sisal, and cotton are the most common. Manila hemp is grown in the Philippine Islands, sisal is grown in Mexico and Yucatan, and cotton is grown in many parts of the world. Most rope is made from manila hemp.

Cotton fiber is twisted into twine or ordinary wrapping cord. Sometimes twine is braided into cord to be used for clothes lines, sash cords, etc. Cotton rope is softer and more pliable than hemp rope, but is not so strong and does not stand dampness so well. Twine used by the farmers to bind grain is made from sisal. Sheep raisers use a twine made from paper to tie wool into bundles. Numerous other kinds of rope and twine are made, depending upon the purpose for which they are intended.

Hemp rope is made by twisting the fibers together to give them strength. These fibers are twisted together into a yarn in a direction known as "right hand." (See Fig. 292.)

From two to eighty of these yarns are twisted together into a strand, in a direction known as "left hand."

Three or four of these strands are twisted together into a rope in a direction known as "right hand."

It is the friction of these fibers against each other that gives a rope its strength. The strength of a rope also depends upon the number and kind of fibers. Manila hemp is stronger than sisal.

Hemp or sisal rope shrinks when it becomes damp and lengthens out again when it dries. A rope should not be allowed to become damp because dampness rots the fibers.

Hemp rope is usually sold by weight instead of by length. Braided rope is usually sold by length.

Perhaps You Would Like to Satisfy Yourself as to Just Where You Stand on Rope Knowledge. The following completion statements and questions will help you find out:

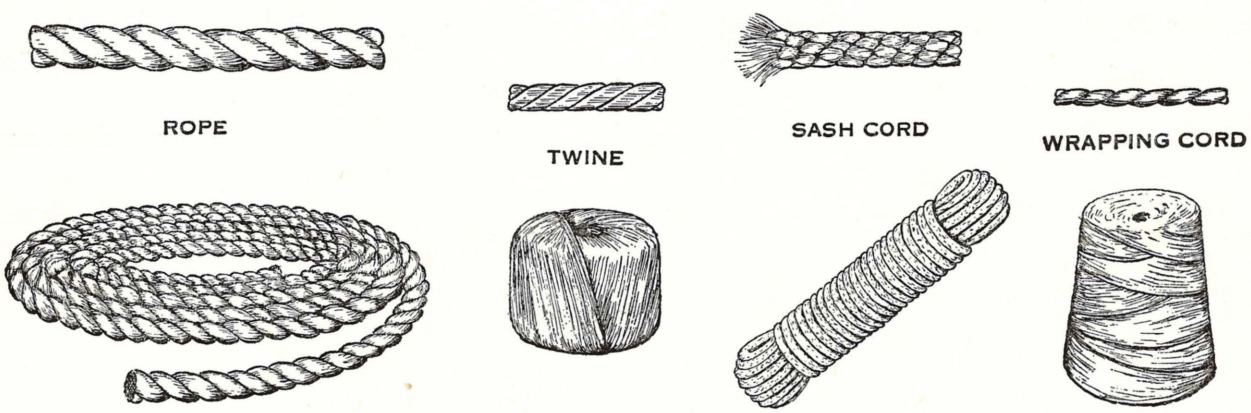


Fig. 527—Rope and twine

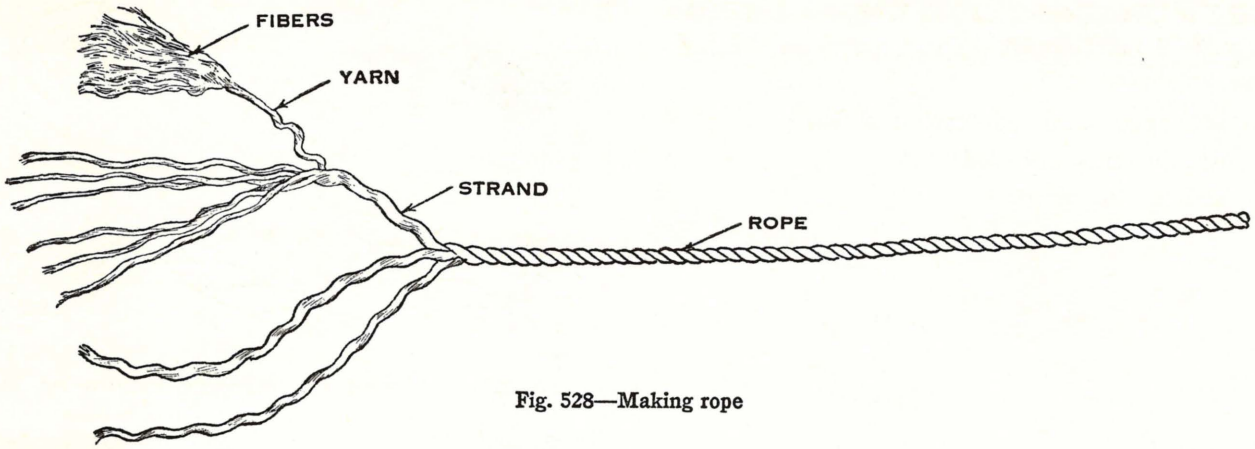


Fig. 528—Making rope

1. List here the knots you can tie: 1._____; 2._____; 3._____; 4._____; 5._____; 6._____; 7._____; 8._____.
2. Ordinary rope is made from _____ fiber.
3. A rope gets its strength from the _____ of the fibers against each other.
4. A fiber known as _____ is used in making the twine used by the farmers in binding grain.
5. Rope is usually sold by _____.
6. The fibers used in ordinary wrapping cord are _____.
7. How many strands are in the ordinary hemp rope? _____.
8. Which is stronger, Manila hemp or sisal? _____.

JOB NO. 122

HOW TO PREVENT A ROPE FROM UNTWISTING

If nothing is done to the ends of a rope, the strands will soon start to untwist. The ends will soon be frayed and will have to be cut off. Then the rope will be shorter than before, for it does not take long to spoil a rope by neglecting it.

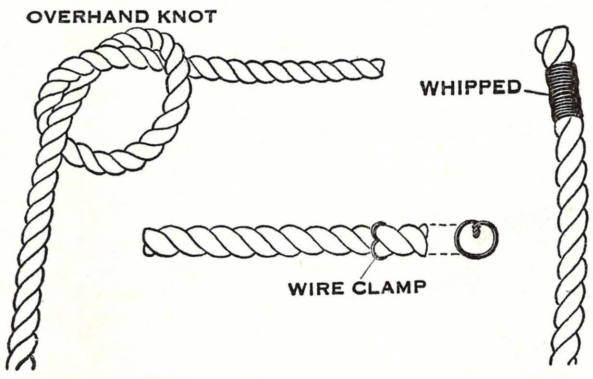


Fig. 529—Methods of preventing a rope from untwisting

Here Are Three Ways of Preventing a Rope from Untwisting.

1. Tie either an overhand or a "figure of eight" knot in the end. This is an effective but clumsy method of preventing a rope from unraveling. The end, tied in this way will not go through pulleys, or small holes. However, this method is sometimes desirable for the very purpose of preventing the end of a rope from passing through a hole or a pulley.
2. Clamp the end with heavy wire. This is a very effective method. The main objection is that the ends of the wire are likely to catch and tear the hands or clothing. The wire must be clamped in place with a hammer or a pair of pliers.
3. Wrap the end with heavy string. This is usually the most desirable method and is called whipping. A piece of heavy cord eight or ten feet long is needed.

Here Is a Good Way to Whip the End of a Rope.

1. Thread the cord through the rope under one strand. Leave three or four inches on loose end, "A." (See Fig. 530.)
2. Give end "B" one turn around the rope and fold end "A" over.
3. Continue whipping until about one-half of the intended distance is whipped. Then fold end "A" back so as to form a loop.
4. Finish whipping the intended distance over the loop.
5. Pass end "B" through the loop; and pull end "A" until the loop draws end "B" under the whipping until the end comes out
6. Cut off the loose ends close to the whipping.

If You Have Done This Job Well, the End of the Rope Will not Untwist. These questions will help you judge your work.

1. Is the cord wrapped closely and neatly?
2. Are the ends concealed?
3. Did you use strong cord?

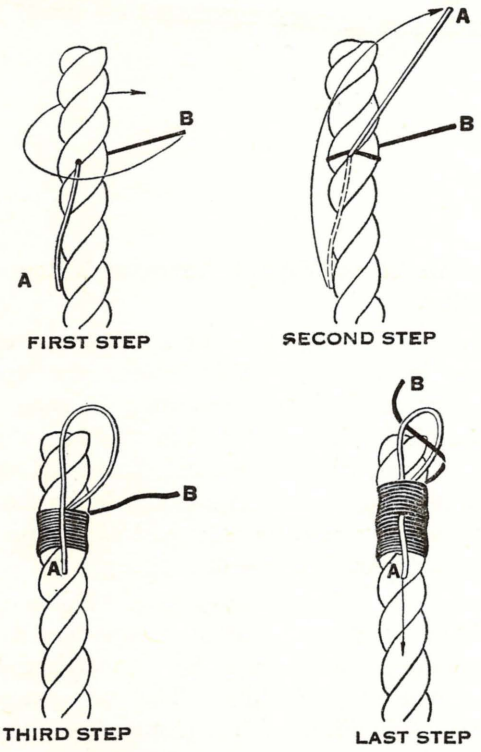


Fig. 530—Whipping the end of a rope

JOB NO. 123

HOW TO TIE SOME USEFUL KNOTS

Few people are able to tie a knot which will hold, without making one which is very difficult to untie. There are about eight knots which will serve the needs of the ordinary person. They are all easy to learn. Ask the Boy Scout; he knows them.

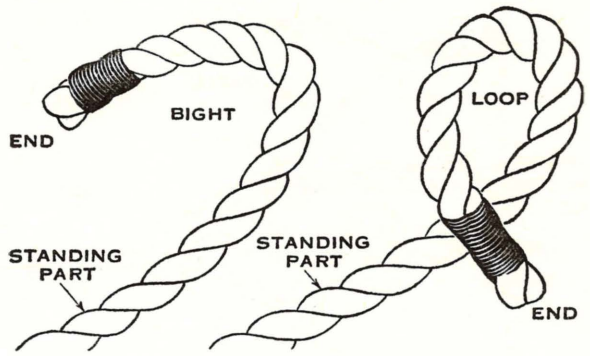


Fig. 531—An illustration of terms used in knot tying

Rope Language

In speaking of rope and knot tying, there are a few terms which should be thoroughly understood before an attempt is made to follow directions in knot tying. These illustrations should explain them fully.

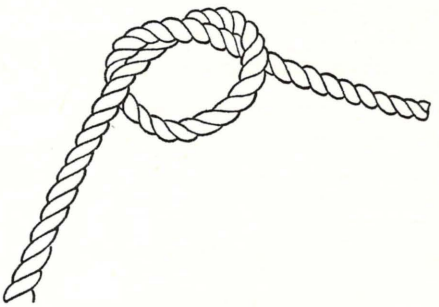


Fig. 532—The overhand knot

Materials Needed:

Two pieces of rope are needed. A piece of cotton sash cord about four feet long is best for one of the pieces, because it is soft and pliable. A larger piece of rope should be used for the other piece.

Here Is the Way Each Knot is Tied, and the Purpose for Which It Is Used. Each knot should be checked as it is done.

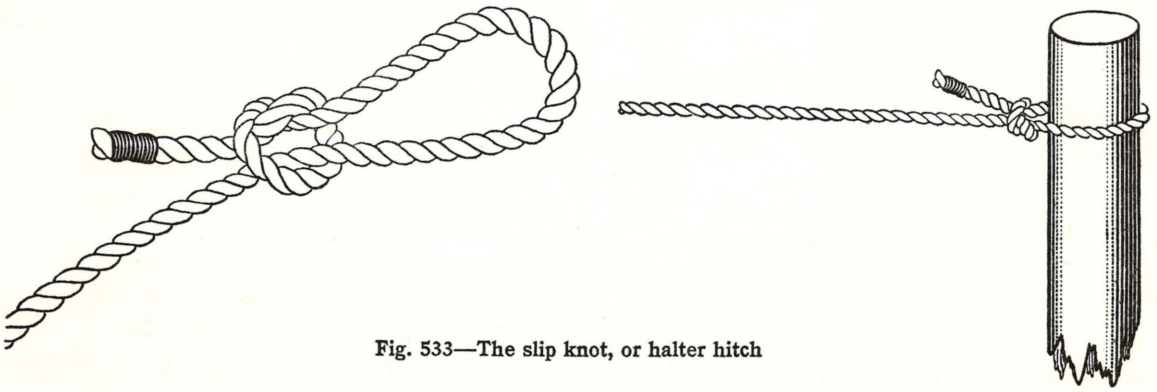


Fig. 533—The slip knot, or halter hitch

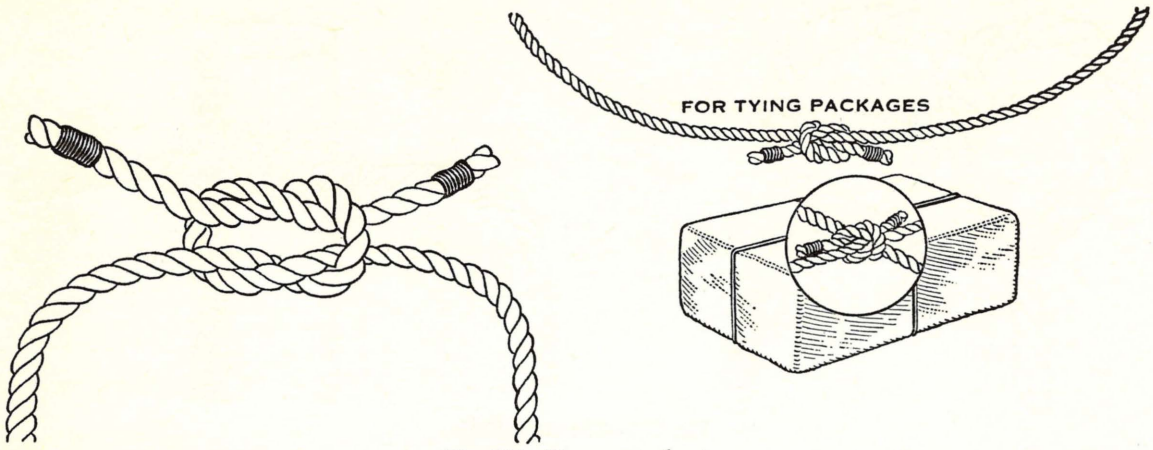


Fig. 534—The square knot

1. **The Overhand Knot.** This is the simplest remedy for keeping the ends of a piece of rope from untwisting. It is also used as a base for a number of other knots, such as the square and slip knots. (See Fig. 532.)
2. **The Ordinary Slip Knot, or Halter Hitch.** This knot is used where a loop which may be drawn tight, or loosened at will, is desired. It should not be used around the necks of animals, as it may draw tight and choke them. (See Fig. 533.)
3. **The Square Knot.** This is the most commonly used, and the most useful knot of all. It is used to tie together two ends of the same size rope or cord. It is especially useful in tying packages, because it does not slip and can be untied more easily than most knots. It should not be confused with the "granny" knot, which does not hold well. Notice that the ends of the square knot come out along the same sides of the standing parts. (See Fig. 534.)
4. **The Sheet Bend** is used in tying together the ends of two ropes of different size, and is easily untied. (See Fig. 535.)
5. **Two Half Hitches.** This knot is very useful in making a rope fast to a tree or pole. In tying packages where only one end of the string is free, as many half hitches may be taken around the cross string as are necessary to make it secure. (See Fig. 536.)

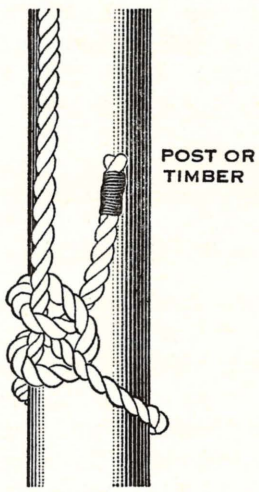


Fig. 536—Two half hitches

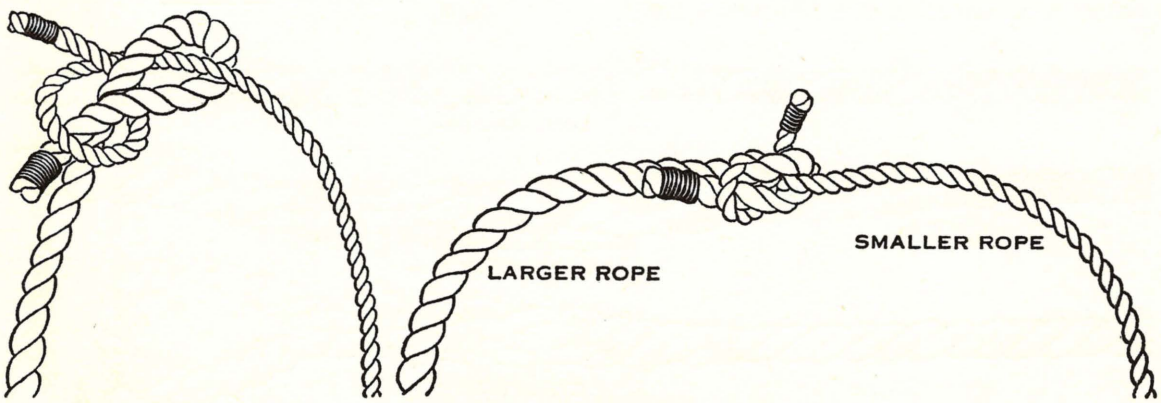


Fig. 535—The sheet bend

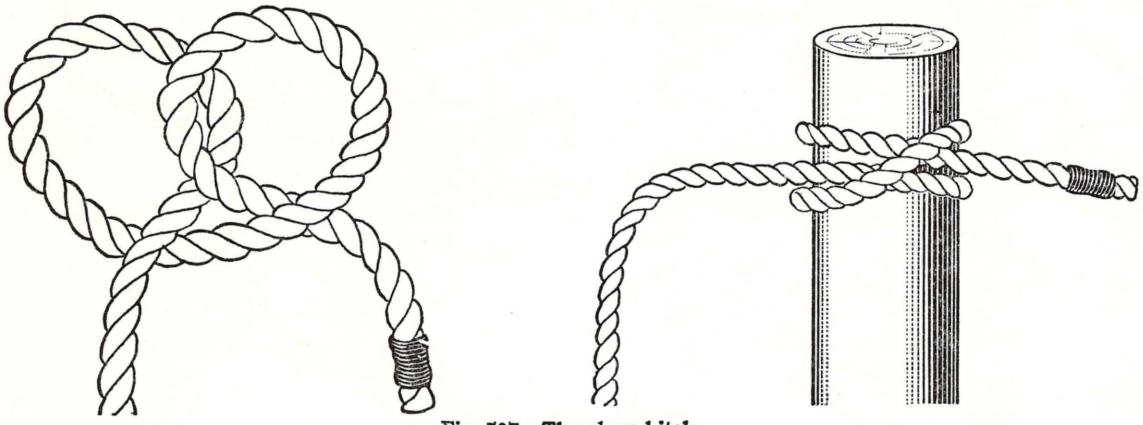


Fig. 537—The clove hitch

6. **The Clove Hitch.** Fishermen use the clove hitch to make a boat fast to a post. It will not slip easily, holds tightly, and may be untied easily. (See Fig. 537.)
7. **The Fisherman's Knot.** Some things which have to be tied, are stiff and do not tie easily. This knot is used by fishermen to tie together two pieces of gut. Notice that it is nothing more than two overhand knots, each tied around the standing part of the other cord. (See Fig. 538.) When tied, the knots slide together, making a single knot.

Fig. 538—The fisherman's knot

8. **The Bowline.** Aside from the square knot, this is perhaps the most useful. It is used in making a loop which will not slip. When tying an animal by putting a rope around its neck, the bowline should be used because it will not draw tight and choke the animal. This knot should be used when tying a tow rope to an automobile. (See Fig. 539.) The bowline knot is simply a combination of a loop and a bight.

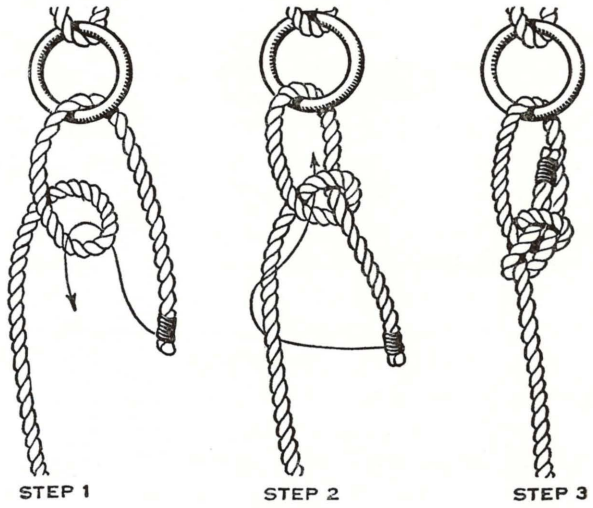


Fig. 539—The bowline

Now That You Have Tied All of These Knots Successfully, See if You Can Close This Book and Tie Any Knot Which the Teacher May Choose.

1. The best knot to use in towing an automobile is the _____.
2. In tying a rope around the neck of an animal the _____ should be used.
3. In tying packages, the _____ is perhaps the most useful.

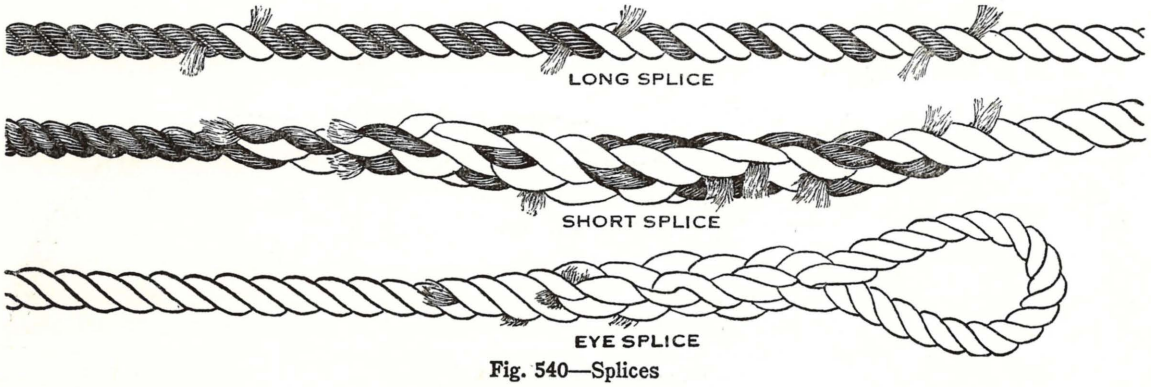


Fig. 540—Splices

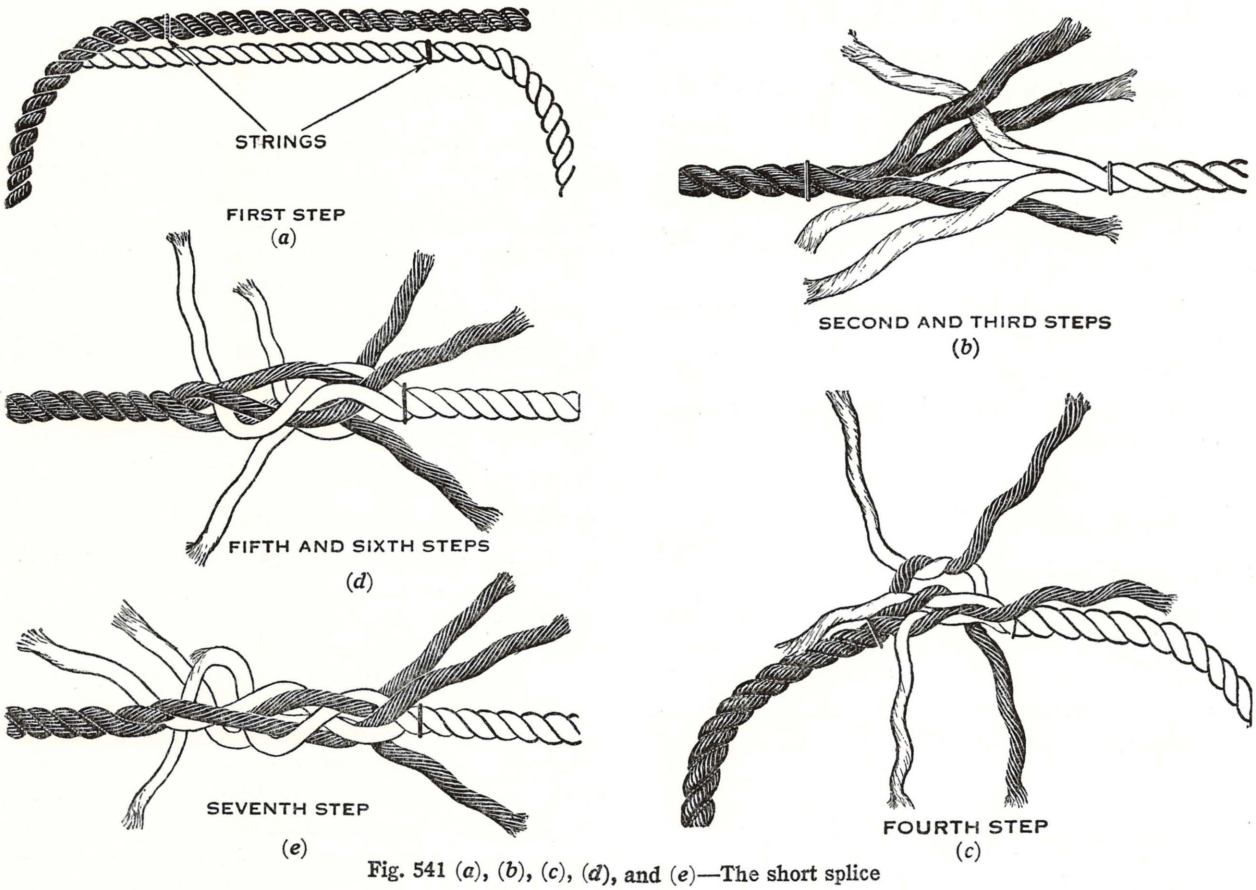


Fig. 541 (*a*), (*b*), (*c*), (*d*), and (*e*)—The short splice

JOB NO. 124

HOW TO SPLICE A ROPE

There are many occasions when the ability to splice a rope may come in handy. Simply tying the broken ends together is not a satisfactory means of making repairs. Splicing is not difficult to learn, although directions must be followed very carefully. Anyone, with a little practice, can learn to do a serviceable, if not an artistic, job. A wooden peg about 8″ long, 1″ in diameter, and tapering to a point, is necessary to start the strands through the rope. This tool is preferably made of hardwood or of iron. When made of iron it is known as a marlinspike.

Types of Splices

There are two types of splices, the short and the long. The short splice is the one most commonly used and is explained here. The long splice is also illustrated. The short splice should not be used when the rope must run through pulleys.

Here Is a Plan For Making a Short Splice. It is very important that you follow directions carefully. (See Fig. 541.)

1. Count eight turns from the ends to be spliced. Tie strings around the ropes at these points.
2. Untwist the strands and open the ends. In opening the ends, be sure that the strands are in the same order as they were when untwisted.
3. Put the two ends together. Be sure that each strand is between two strands of the opposite end.
4. Tie overhand knots in each pair of strands. Tie the knot in its right-hand form.
5. Draw the knots up tight. Each one of the knots will have to be drawn a number of times before all the knots are tight.
6. Remove the string from the right-hand end of the knot.
7. Weave each of the strands on that side. Each of the strands should pass over the one next to it and under the second one. This should be done twice around the rope.
8. Cut out about one third of each strand and weave twice again. This process of thinning is to taper the splice. It should be repeated until all of the loose strands are used.

9. Cut the string on the other side of the knot and finish in the same manner.
10. Place the splice on a board or on the floor and roll it with the foot. This works the strands in place and makes the splice smaller.

Now That the Splice Is Completed, Just How Good Do You Think It Is? These questions may help you decide.

1. Does the weave of the splice appear uniform all over?
2. Are the strands tightly woven?
3. Do you think the splice is as strong as the rest of the rope?

JOB NO. 125

How to Make an Eye Splice

An eye splice is so much smaller and neater than a knotted eye in the end of a rope that it is much preferred. It is made almost the same as the short splice. By following instructions closely it can be learned easily. (See Fig. 542.)

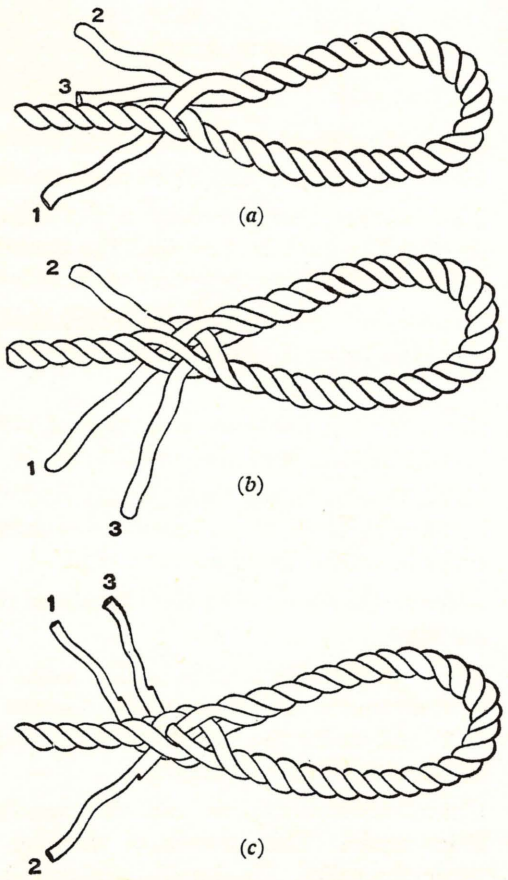


Fig. 542 (*a*), (*b*) and (*c*)—The eye splice

Here Is a Good Way To Do It:

1. Untwist the strands on one end of the rope and tie as for a short splice.
2. Form an eye in the rope back of the untwisted part.
3. Weave each strand between two strands of the standing part. No two of the loose strands should be between the same two strands of the standing part.
4. Proceed from this point as for the short splice.

Did You Make a Good Eye Splice? These questions may help you decide.

1. Is the splice even and well tapered?
2. Does the splice seem solid?
3. Is the splice as strong as the rest of the rope?

JOB NO. 126

HOW TO MAKE A LONG SPLICE

A long splice is necessary when a rope must pass through a pulley, or when the rope is used to drive machines or go over the pulleys of a rope drive. A long splice is shown in Fig. 540. One strand from each end of the ropes to be spliced is unraveled and laid in the space just occupied by the corresponding strand, the ends being left a little long, and the corresponding strands cut off, leaving the ends a little long also. The ends are then unraveled to taper the strand down almost to a point. These ends are laid past each other and tucked under the other strands. The strands that meet in the center of the splice are cut off and tucked in in the same manner. The rope is now the same size throughout, except at the three splices. These points are now rolled to bring the rope to the same size throughout.

Wire rope or cable is spliced in a similar manner, but very careful workmanship is required through the entire job.

JOB NO. 127

HOW TO MAKE A ROPE

Most people never think of making a rope for themselves, because rope can be purchased cheaply. However, occasions do arise when a rope is needed and none can be purchased. It is very easy to make a rope, but of course it will not ordinarily be as good as a regular factory made rope.

Necessary Materials:

The materials depend upon the kind of rope desired, and the kind of materials to be had. Cotton wrapping cord or sisal binder twine will do very nicely. Cotton string of different colors make a very attractive rope.

Necessary Equipment:

Something will be needed to use in twisting the fibers or strands. A small hand drill is excellent.

Here Is a Plan for Making Rope.

1. Cut the cord or twine for the strands. The strands should have from two to six cords, depending on the strength of cord desired. The strand should be about four times the length of the cord desired.
2. Twist the cords into one long strand in the left-hand direction. This is done by making one end fast to a nail, and attaching the other end to a hand drill. Keep the strand taut and twist until it begins to kink badly. Allow it to untwist and then twist it again.
3. Cut strand into three equal lengths and twist together in the right-hand direction. Keep the strands taut while twisting.

Did You Make a Good Rope? These questions may help you decide.

1. Is the rope evenly twisted?
2. How many strands are in the rope?
3. How many cords are in each strand?
4. Does the rope stay twisted?

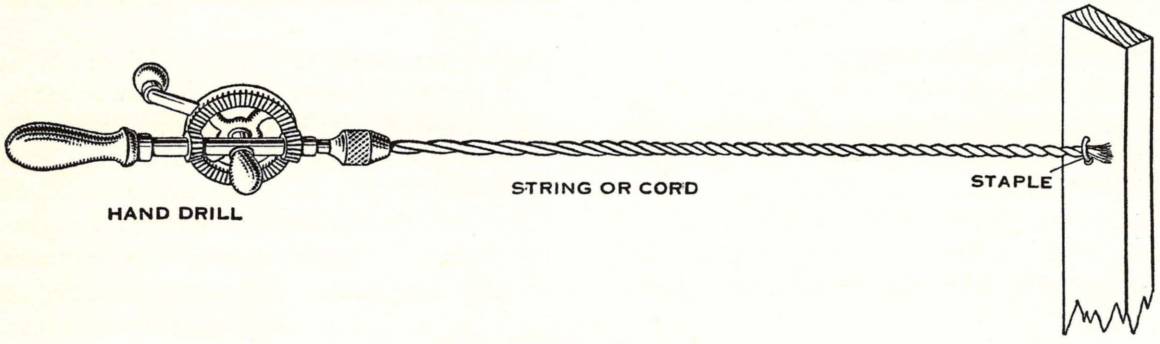


Fig. 543—Twisting a rope

The Home Workshop

Chapter 10

HOW often have you stopped in front of a hardware store display of tools and said, "Boy! I wish I had all of those tools"? If somehow your wish had been granted, the chances are that you would not have known what to do with them after they were in your possession. The successful home workshop is not usually outfitted that quickly. The home workshop usually starts with a few tools, and a person who actually uses them. He may not be an expert craftsman, but he must have an interest in working with tools. He learns with experience, and as he progresses, he adds new tools and machinery until eventually he has a well equipped shop. People are often oversold by attractive displays. They spend large sums of money for home workshop tools and machinery, only to discover that they are not able to turn out the beautiful things they had planned. The safest plan is to begin with a few simple tools, and add to them as your skill and interest progresses.

Outfitting the Home Workshop

A few simple tools will meet the needs of the household mechanic who plans on nothing more than keeping the faucets working, the light plugs in order, etc. It is not even necessary that he have a regular workshop, but he should have a place to keep his tools. A couple of orange crates nailed up in the garage or basement may serve the purpose. Possibly a portable tool chest which can be carried from place to place will meet his needs better than a tool panel in the basement or garage. This is something which must be decided by the household mechanic himself. If his interest runs to making toys, novelties, furniture, or jewelry, the household mechanic will want a number of woodworking or metalworking tools. The more advanced craftsman will probably want power tools and equipment. The following suggestions are intended to help the mechanic in selecting tools and equipment for his workshop or tool kit.

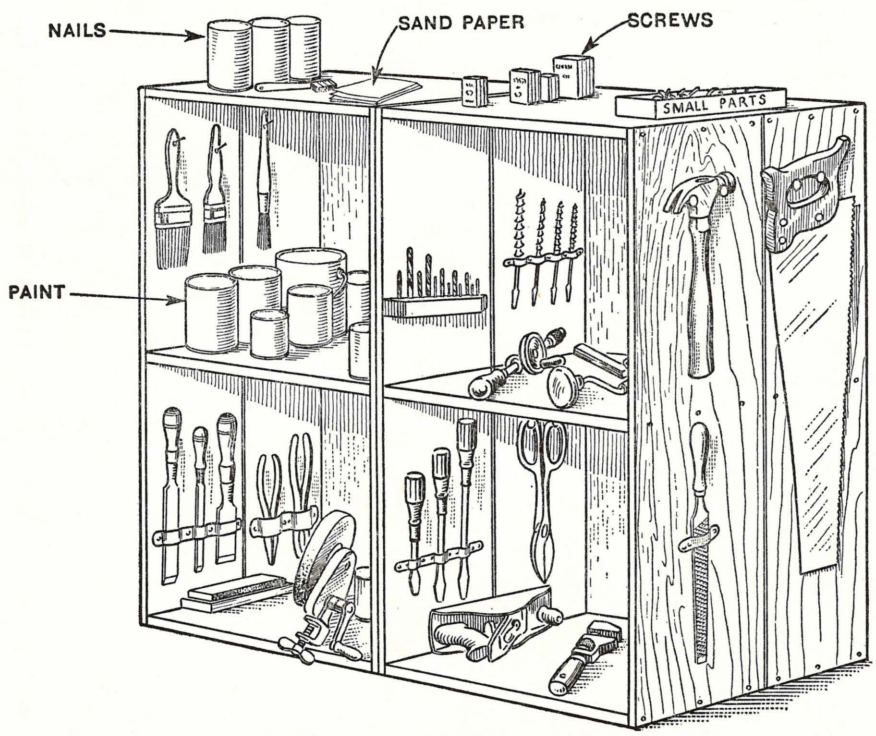


Fig. 544—A couple of orange crates nailed to the wall of the basement or garage may serve as a tool cabinet for the beginner

The Bare Necessities Tool Kit

There are a number of more or less standard repair jobs to be done around the home. If the household mechanic has the equipment listed in the bare necessities tool kit, he can take care of almost any ordinary job. This does not mean that the beginner must have all of these tools. He may start with a screw driver and a pair of pliers, or any other of the tools listed. But eventually, he will need all of them. If he finds that he likes to work with tools, there is no limit to the number of tools he may buy.

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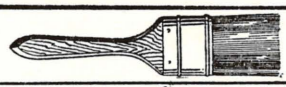
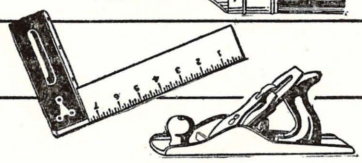
 PAINT BRUSHES							✓
 TRY SQUARE					✓		✓
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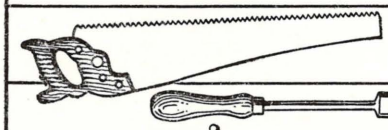
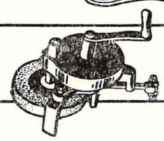
 CROSSCUT HAND SAW					✓		✓
SOLDERING COPPER							✓
 HAND GRINDER						✓	
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 FILE						✓	
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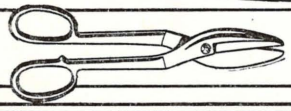 TIN SNIPS				✓			✓
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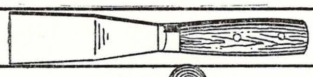
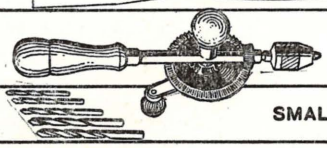
 PUTTY KNIFE				✓			✓
 HAND DRILL			✓	✓			✓
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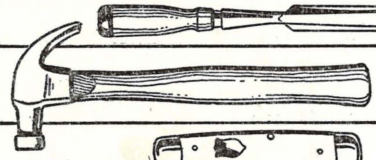
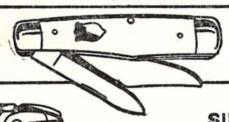
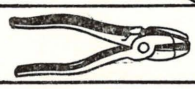
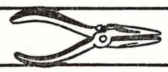
 1" WOOD CHISEL			✓	✓			✓
 16 OZ. CLAW HAMMER			✓	✓	✓		✓
 KNIFE		✓	✓				✓
 SIDE CUTTING PLIERS		✓					✓
 LONG NOSE PLIERS		✓					
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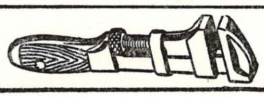
 MEDIUM SIZE SCREWDRIVER	✓	✓					✓
 10" MONKEY WRENCH	✓						

Bare Necessities Tool Kit for the Home Workshop

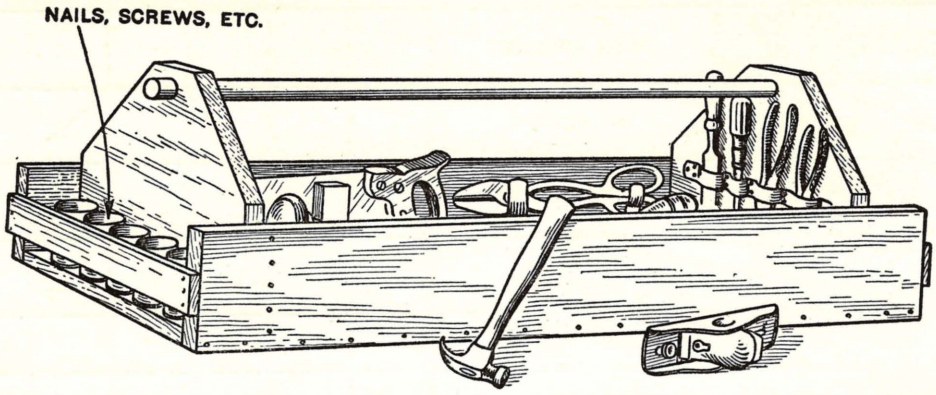


Fig. 545—A portable tool kit, built to suit the needs of the household mechanic, is handy for carrying tools and materials to the job

The Arrangement of the Home Workshop

It is nice to have a large workshop with plenty of room to build a boat or a trailer if desired. But hundreds of expert craftsmen are perfectly happy with a small bench built under a stairway, or in a small corner of the garage. A lot of work can be done in a small corner if the space is used to good advantage. When starting a home workshop with serious intentions, the household mechanic should ask himself the following questions.

1. Is there room for a work bench?
2. How large can the bench be?
3. Will there be room to work after the bench is installed?
4. Is the ceiling high enough for the worker to stand up straight?
5. How about ventilation?
6. Can lighting be arranged?
7. What about wall space for hanging tools?
8. Is there any storage space for supplies?

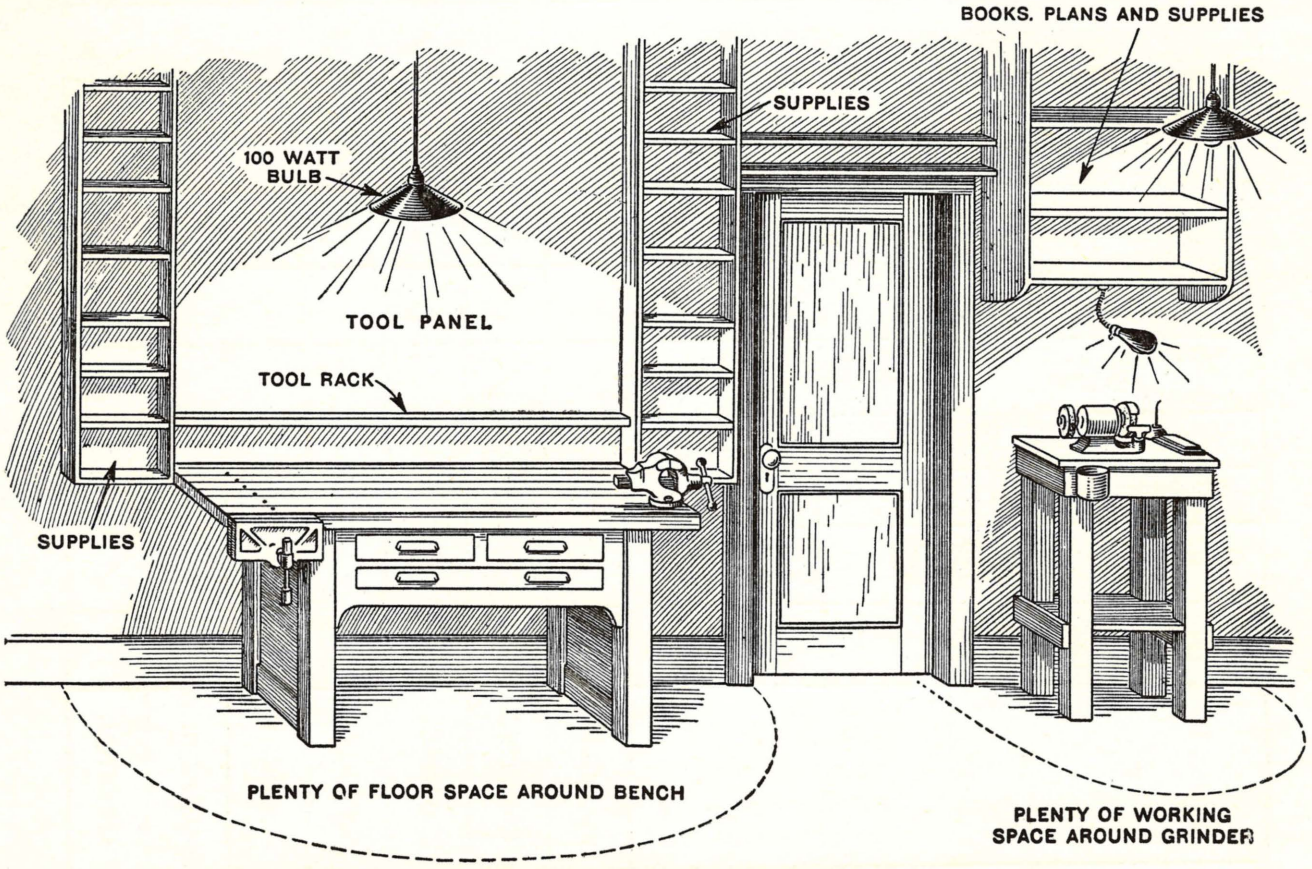


Fig. 546—This shop meets most of the requirements of a well arranged home workshop

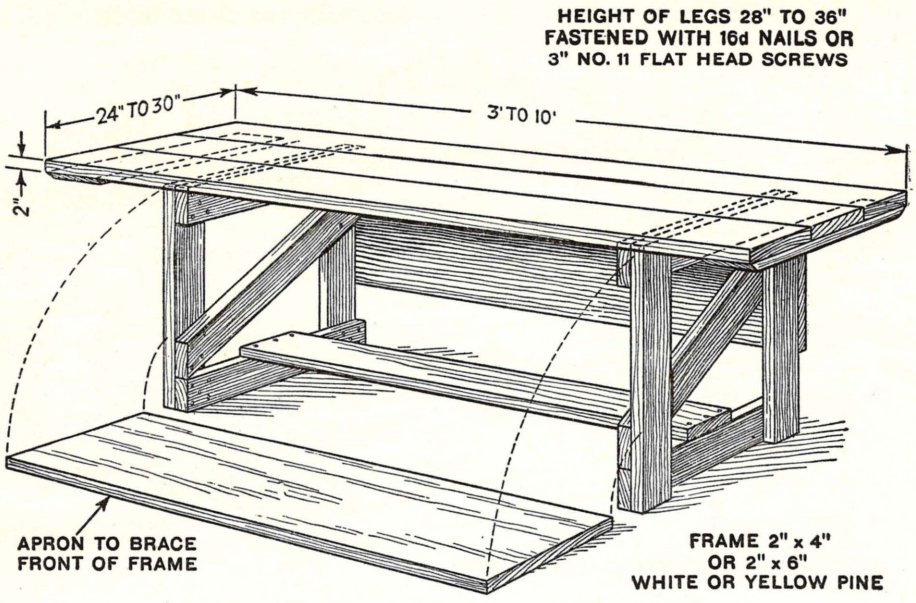


Fig. 547—A sturdy bench can be made at home

9. Is there room for the addition of more equipment?
10. What kind of floor is there? Cement floors are bad for tools that are dropped.
11. Is the place damp? Dampness rusts tools.
12. Is there enough heat in the winter so that one may work with comfort?

It is probable that there will be something wrong with most any space available in the modern home. The floor space in the garage may be good, but it is too cold during winter months. The basement may be damp, but it is handy, and comfortable during the winter. The household mechanic who really wants a shop will usually overlook a few objections.

The Work Bench

If the household mechanic finds that he really likes to work with tools, he will probably want a work bench. First, a location for the bench must be found. It may be located at most any place from the attic to the barn. The basement is a very common location because it is handy, and the bench can be used both winter and summer. It has the disadvantage that it is usually damp during the summer. Tools will rust unless they are kept well oiled.

Once the location of the bench has been selected, the size and shape of the bench may be planned. It should be as large as possible without crowding the floor space. The top may be made of 2″ planks, or heavy laminated maple. The legs may be made of 2″×4″ lumber nailed together, or of oak or maple put together with mortise and tenon joints and bolts. The entire bench may be made at home or purchased ready to use. Whether it is made at home, or purchased already made, the bench should be solid, should be the right size, and should meet the needs of the user.

Equipment For the Work Bench

The equipment for the work bench will vary according to the kind of work the household mechanic expects to do. Most benches have a woodworking vise on one end, and a metal-working vise on the other. Few household mechanics have enough room in their workshop for a separate bench for metal-working. Some kind of pad is necessary

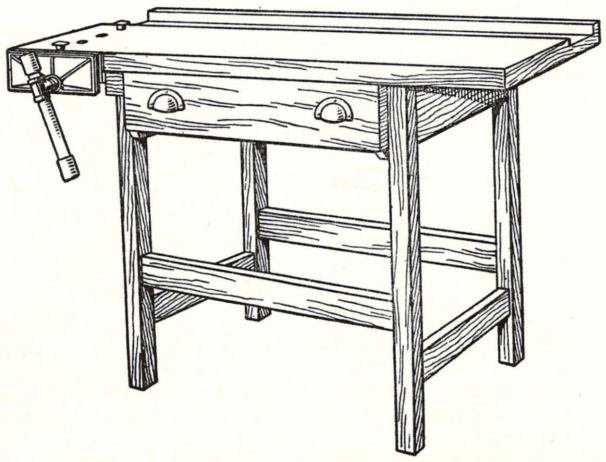


Fig. 548—A bench can be purchased ready for use

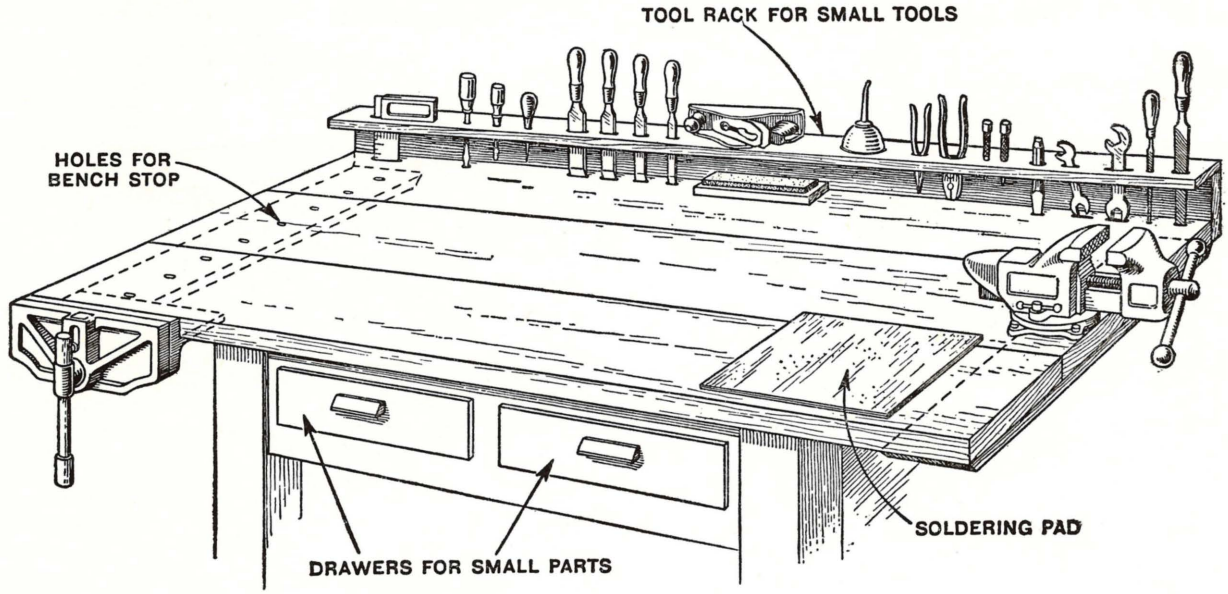


Fig. 549—Suggestions for equipping the work bench

to prevent burning the bench top if one expects to do any soldering. A large asbestos shingle is excellent for this purpose. Space for a hand grinder is necessary unless the household mechanic is fortunate enough to own a motor grinder. It is impossible to list all of the equipment one may have on a bench. If the household mechanic has the equipment mentioned above, he has an excellent start. More can be added from time to time as new jobs are attempted.

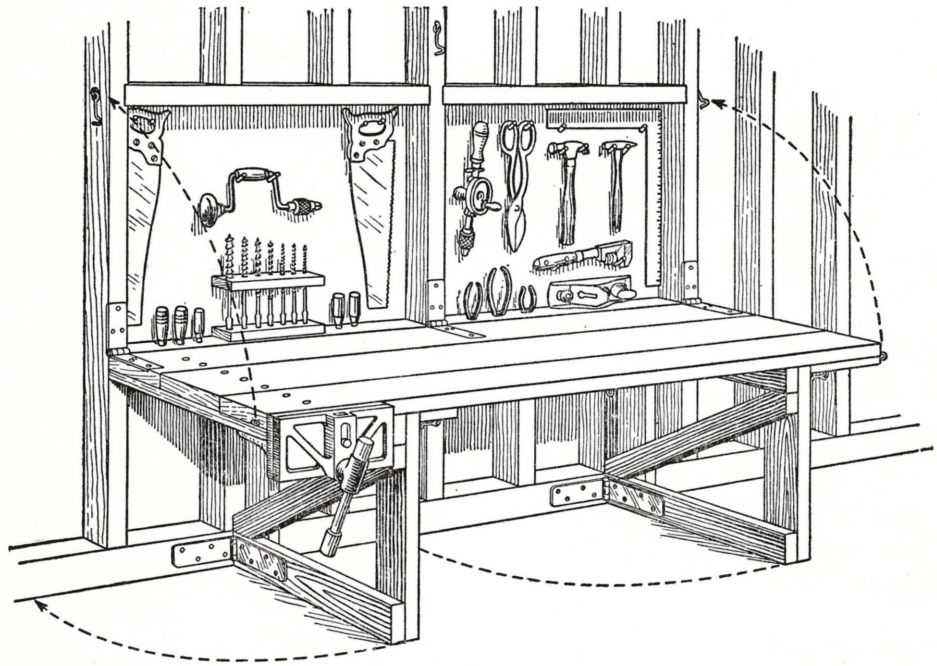


Fig. 550—One household mechanic has solved the space problem for his work shop in this manner. His only space was at the end of a one-car garage, but there was not room enough for both car and work bench. So he hinged the top of his bench to the 2″×4″ studdings. This permitted him to fold his bench top against the wall, where he fastened it with hooks when not in use. This also made a safe place for his tools. The legs were also hinged so that they could be folded back against the wall. The only inconvenience was that his car had to be backed out of the garage when he wanted to use the workbench.

The 2″×4″ studdings were cut away for the tool panels, and panels of plywood were inserted to reinforce the siding at that point.

General Facts About Tools

One of the best ways to judge a workman is to examine the tools he uses. If he is a good workman, his tools will be sharp and in good working condition. Tools should always be kept sharp, clean, well adjusted, and in good repair. By keeping them so, they are much easier and safer to work with, and will last much longer.

Fig. 551—The shape of the tool painted on the tool panel will help to keep tools where they belong

Tools without handles, or with broken handles, should not be used. Many persons have been injured by using a file without a handle. Loose hammer handles have caused many serious injuries. Flying pieces of metal from burred cold chisels have caused many people the loss of their eyesight.

The household mechanic should know what to expect from a tool in order to get the best service from it. A special kind of steel known as tool steel, is used in making tools. But the steel is not the same in all tools. Some steel is very hard and brittle, while some is very tough. The steel used in a razor blade is very hard because it must hold a keen edge. The steel used in a wood chisel is also very hard, and striking a nail or sometimes even a hard knot in the wood will chip or nick the cutting edge. The steel used in a hand saw is softer and tougher. Striking a nail while sawing will take the cutting edge off a large number of teeth before the hand can be brought to a stop. If the steel were hard, the same number of teeth might be broken out. The steel used in an auger bit is soft and tough so that the workman can touch up dull spots in the cutting edges with a bit file. If the steel were

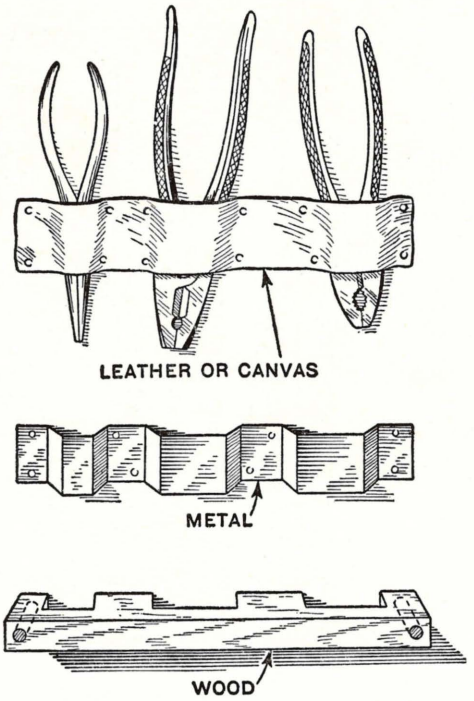


Fig. 552—Pliers do not hang well on hooks. Excellent holders may be made of other materials

hard and brittle, the spurs would be broken off. The steel used in a cold chisel must be very tough in order to stand hard blows with the hammer while cutting metal. If the metal in a cold chisel is too brittle, it will break when struck with the hammer. If the metal is too soft, the edge will turn over. Good tools, therefore, are made of the kind of steel best suited to their uses.

Few tools actually wear out. They are abused so much that they break, or become so battered they do not work properly. Much of this abuse is due to improper storing.

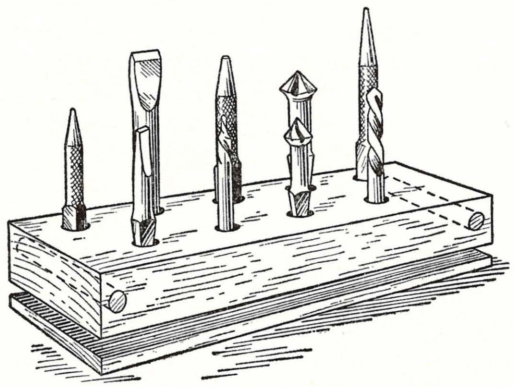


Fig. 553—A wood block with holes drilled through it works very well for punches and cold chisels. An extra block below keeps them from falling through, and permits the dirt to be cleaned out

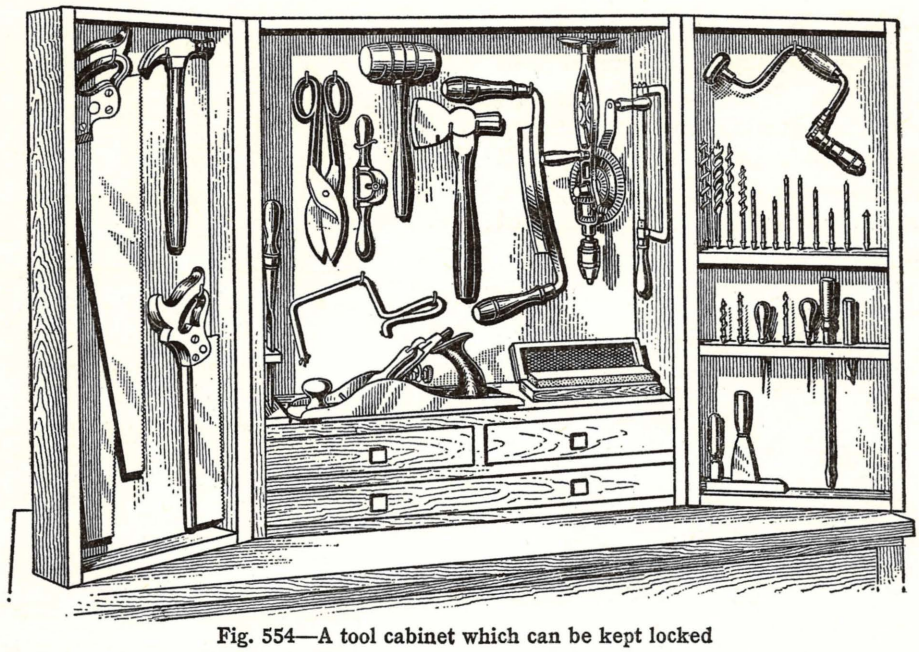


Fig. 554—A tool cabinet which can be kept locked

Storing Tools

"A place for everything and everything in its place," is a good maxim. Tools should always be kept in their places. A work bench with tools carelessly strewn about indicates that the owner is careless. Much time is wasted looking for tools if they are not kept in their places. The household mechanic often blames other people for not putting tools back after using them. If the shape of the tool is painted on the panel where it is supposed to be hung, "the other fellow" has no excuse for not knowing where it belongs.

Tools should be arranged so that they are handy. A well-arranged tool rack above a work bench is an added inducement for making things at home. There is much difference of opinion as to just what is a handy arrangement of tools. Some people like to hang tools on the wall, or on a tool panel. Some like a rack on the back of the bench. Other people like to keep them in a cabinet which can be locked. Then, there are some tools which do not hang easily, and should be kept in a drawer or on a shelf.

Tools should be hung where there is no danger of their falling and injuring someone. This is likely to happen if they are hung overhead where a person may strike them while passing.

Tools should be hung where there is no danger of their falling and breaking. Well-designed pegs, hooks, or shelves will prevent tools from falling. Tools should be placed beyond the reach of small children, for they do not understand how to use tools and may injure themselves.

Tools should be kept sharpened and adjusted. It is much easier and safer to use a tool which is sharp and set right, than one which is dull or poorly adjusted. There is less danger of breaking a tool

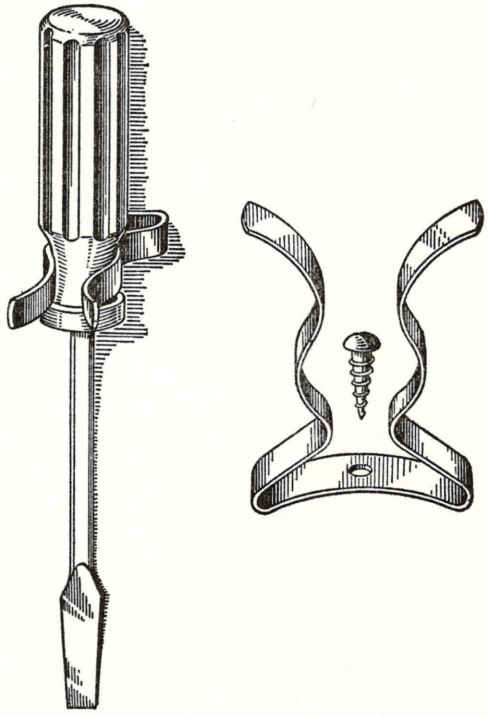


Fig. 555—To hang screwdrivers, chisels, etc., patented clamps may be bought at the hardware store

which is in good working condition, because less force has to be used to operate it. Time will be saved if tools are always ready for use.

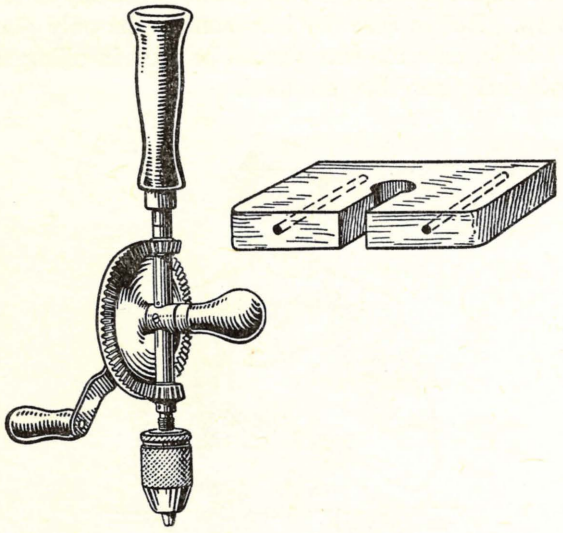


Fig. 556—A wood block with a slot sawed in it is excellent for a hand drill

Cutting tools should never be laid on their edges, for the blade may be dulled by coming in contact with the bench, nails, or other hard objects. A plane, for instance, should always be laid on its side when not is use. If it must be set on its face when it is put in the tool rack, a block of wood should be placed so that it holds the blade up off the shelf. (See Fig. 554.) Otherwise the blades should be run back inside the face. Tools such as saws should always be laid flat or hung properly. Never lean a saw against anything, or lay it on other tools.

If possible, have a wood or linoleum floor around and under the work bench. Dropping tools on a cement floor is almost certain to damage them.

Tools such as drills and auger bits are best kept in racks especially made for them. Auger bits are often kept in a drawer where the size number can be seen quickly.

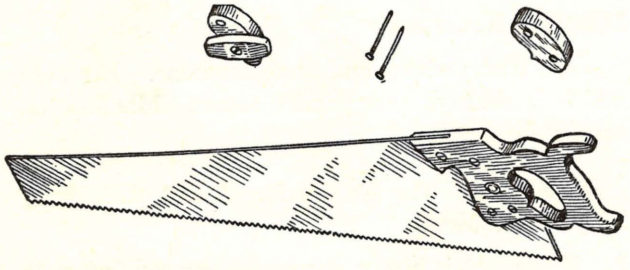


Fig. 557—Drive two nails or two screws in the wall or cut a block of wood to fit the handle of a saw. A turn-button will keep the saw from falling off

JOB NO. 128

HOW TO STORE GARDEN TOOLS

Garden tools should not be stacked in a corner of the garage, or hung on fences. They are valuable tools the same as bench tools, and are deserving of a rack, or some form of hanger to keep them in. They should also be hung so that small children will not pull them down on their heads. The following suggestions have been tried, and work very well.

No plan of work is given for any of these ideas because each one has to be worked out to fit the tool and to suit the place where the tool is to be kept. There is no limit to the number of ideas which can be worked out along this line. These are suggestions. Try it yourself and see what you can do. You may be able to develop something new.

How To Prevent Tools From Rusting

Rust is caused by the chemical action of air and moisture on things made of iron or steel. It can be prevented by coating the metal with some kind of

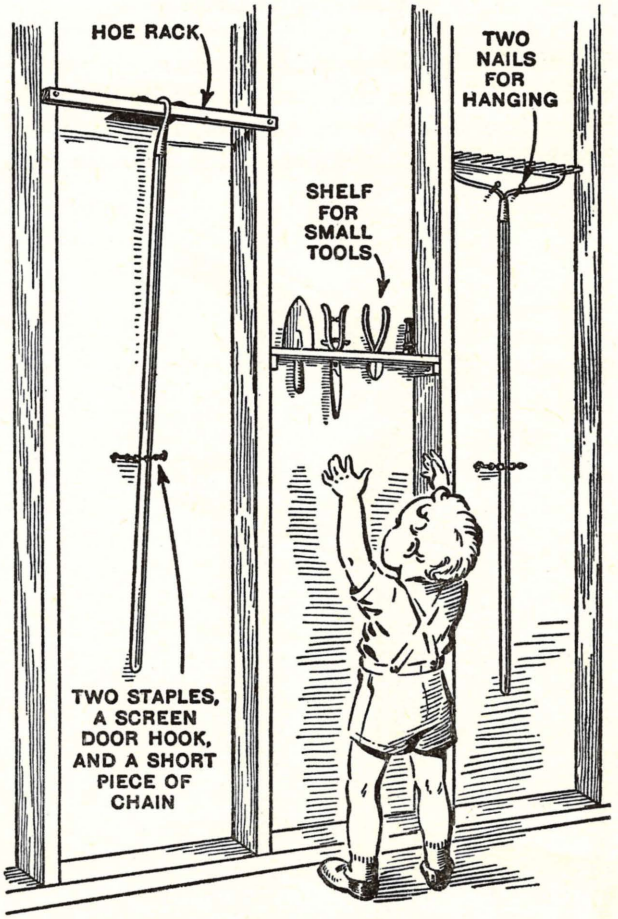


Fig. 558—Tools should be kept out of the reach of small children

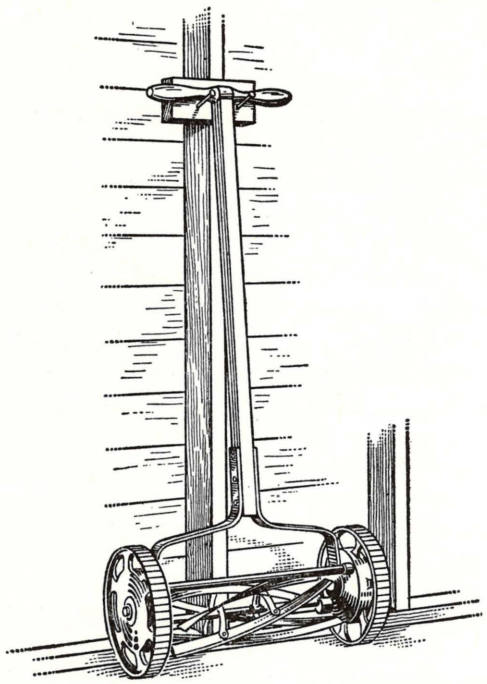


Fig. 559—The lawnmower may be hung against the wall or studding of the garage

film which keeps the air and dampness away from the surface. Oil is the most satisfactory for the working parts of a tool, because it does not in any way interfere with the operation of the tool. In fact, it makes the tool easier to operate. Paint, lacquer, or enamel is used on other metal parts.

Tools should be kept in a dry place if possible. A basement is often a poor place, especially if it is damp. But in case the basement is the only place available, extreme care should be used in oiling the tools each time they are used.

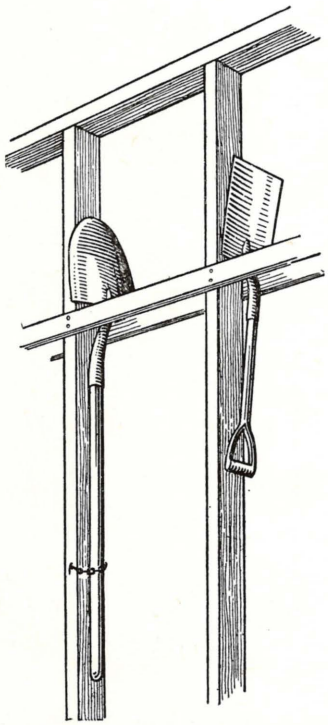


Fig. 560—Tools may be hung between bare partition studdings

Fig. 561—Keep tools covered with a thin film of oil to prevent rust

Wipe all parts carefully with a rag which has been soaked with a good mineral oil. Vaseline is sometimes used.

Caution: Do not use linseed oil, or other drying oil, because it will form a tough, sticky film on metal surfaces.

JOB NO. 129

HOW TO REMOVE RUST FROM A TOOL

It often happens that a tool is neglected and becomes rusty. The tool should be cleaned as soon as possible, before the rust eats too deeply into the steel. Then be sure to see that it does not happen again.

Materials Necessary:

No. 0 emery cloth, and some kerosene. If a high polish is desired, use pumice stone. Machine oil should be used.

Here Is the Way To Do It. A Lot of Rubbing May Be Required.

1. If the rust is heavy, it may be scraped first with a cold chisel or the end of a file.
2. Soak the rust spots with kerosene.

3. Rub with emery cloth until all traces of rust have been removed.
4. Remove all traces of kerosene with a dry cloth.
5. If a high polish is desired, rub with pumice stone and machine oil.
6. Clean with a dry rag, and apply a thin film of machine oil to prevent further rust.

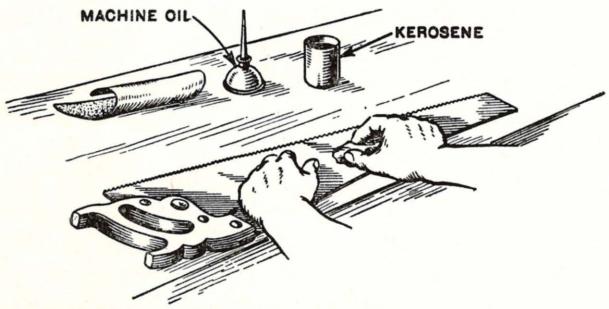


Fig. 562—Rust may be removed with kerosene and emery cloth

Are You Satisfied With the Job You Did. Answer these questions.

1. What causes rust?
2. How can rust be prevented?
3. Why is pumice stone used?
4. Can you figure out why kerosene is used?
5. Why was machine oil recommended after the job was finished?

JOB NO. 130

HOW TO CLEAN GARDEN TOOLS AND KEEP THEM FROM RUSTING

Garden tools should not be put away dirty. Moisture in the dirt which sticks to them causes them to rust. Garden tools should be kept clean and bright, the same as a farmer keeps his plow. They do not scour unless they are kept clean and bright. A tool or plow scours when the dirt slides off the blade and does not stick. A tool that scours is many times easier to use than one which does not. It is not difficult to keep a garden tool in that condition. Hoes, trowels, spades, and shovels should scour. Rakes cannot be expected to scour, but should be kept clean anyway.

Materials and Equipment Needed:

It is a good idea to nail a shelf or box on the wall near where the tools are kept, containing the following. An old putty knife, or wooden paddle for scraping the dirt off tools. A wire brush for further cleaning, a dry rag for wiping the surface dry, and a rag soaking in old cylinder oil, or machine oil.

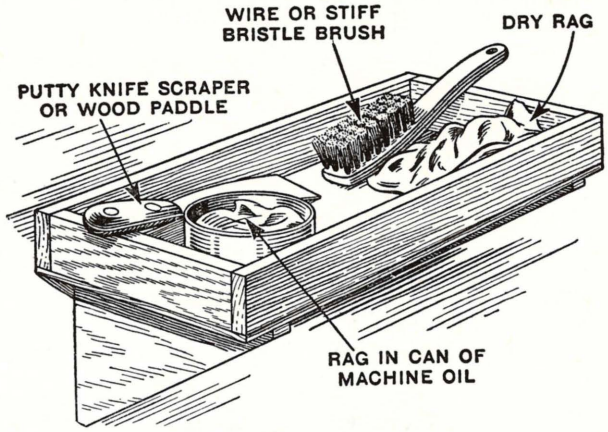


Fig. 563—Keep a box with cleaning equipment near the tool rack

Here Is the Way It Is Done. It really doesn't take much time.

1. If the tool is rusty or dirty, it will have to be cleaned. (See Job No. 131.) If the tool is new, and covered with paint, the paint will have to be cleaned off, if it covers the working surfaces.
2. After using, clean the dirt off with a wooden paddle or putty knife. If the tool scours prop-

Fig. 564—Keep the dirt cleaned off the hoe by using a small paddle

erly, there will not be much dirt to clean off. It is a good idea to carry a paddle while working and if the tool does not scour properly, clean the dirt off as often as it accumulates. If this is done regularly for a few times, it will help the tool to scour. Hoeing or digging in hard soil helps polish the metal and makes it scour better.

3. Brush off any dry dirt not removed by the paddle, with the stiff bristle brush.
4. Wipe the surface dry with the dry rag. All traces of moisture must be removed.
5. Wipe all bare metal surfaces with a rag soaked in machine oil. The rag need not be dripping with oil, but oily enough to leave a generous coating on the surface of the metal. This will prevent rust and keep the surface bright and shiny. When the tool is used again, the first few strokes will remove the coating of oil and dirt will not stick to it.

If This Procedure Is Followed Regularly, Garden Tools Will Not Rust.

1. What causes rust?
2. What does oil do to prevent rust?
3. Why should a tool scour?
4. Would you expect a rake to scour?
5. What effect does using a hoe in hard soil have in making it scour?

Fig. 565—Tools should be oiled before they are put away. A rag soaked in machine oil is a convenient method

Why Sharpen Tools

A good workman always keeps his tools sharp. He keeps them sharp for a number of very good reasons. In the first place, he could not be a good workman if he tried to use dull tools. It takes so much strength to make a dull tool cut, that it is hard to control the tool. Sharp tools are safer than dull tools. They cut with so little effort that it is easy to control them. Many tools are broken because people try to force them to cut when they are dull. One of the reasons why beginners do poor work is because they do not realize the importance of keeping their tools sharp. If they would take the time to keep their tools sharp, they could do better work and more of it. Carpenters spend rainy days sharpening their tools. They have learned that it is worth while.

What Is Meant By Sharpening a Tool?

Sharpening a tool means dressing the cutting edge so that it will cut easily. Enough metal must be removed from the cutting edge so that the nicks are gone. The cutting edge is thinned down to a perfect wedge or bevel which will do the work required of the tool. The cutting edge must be

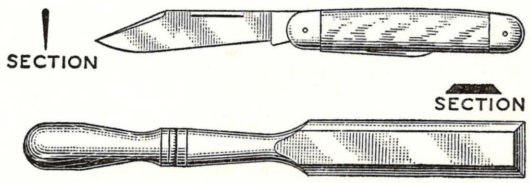


Fig. 566—A chisel is a beveled-edge tool. A knife is a wedge-edge tool

keen and sharp so that the tool will operate easily. The method of doing this depends on the kind of tool, and how badly it needs sharpening.

Grinding Tools To Shape

Most tools are ground on some kind of grinding wheel in order to shape their cutting edges properly. Many metal working tools need no further sharpening. The household mechanic should be very careful in his selection of a grinder in order that he may get one which will meet his needs.

It is generally admitted that the grindstone is best for sharpening wedge-edged tools. The grindstone is always run at a slow speed. The wheel either runs in water, or has water dripping on the surface. This cools the tool being ground, so that there is no danger of burning the tool. The fine grain of the grindstone produces a good edge. The grindstone can also be used for beveled-edge tools. It cuts more slowly than other types of grinders, but it is much easier and safer to use. Always be

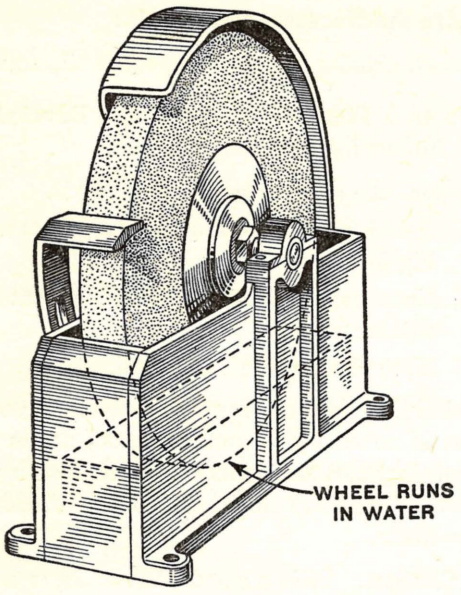


Fig. 567 (*a*)—A handy grindstone to be run by a motor

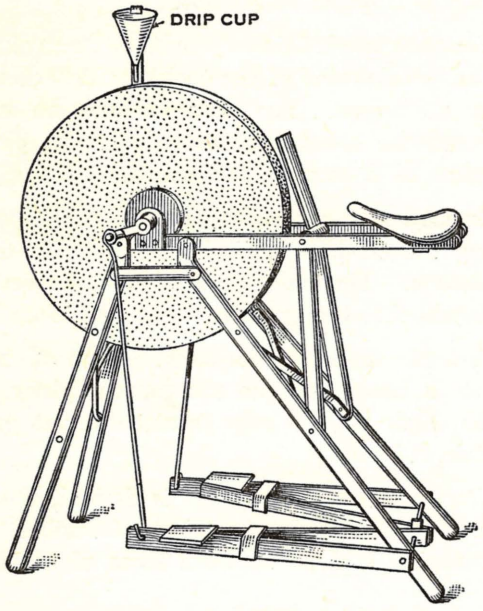


Fig. 567 (*b*)—A grindstone is excellent for sharpening kitchen knives and other wedge-edge tools

sure that the tool is free from oil or grease before grinding it on a grindstone.

Either the motor or the hand tool-grinder is very convenient for the home workshop. Grinding wheels varying from fine to coarse may be used. The grinder is driven at high speed, and no water or oil is used on the wheel to cool the tool while grinding. There is danger of burning tools while sharpening them on a grinder. The wheel cuts so rapidly that it generates a great amount of heat. A better edge will result if very light pressure is put on the tool. The tool should be constantly moved back and forth across the face of the wheel. The tool should also be dipped in cold water frequently to keep it from becoming too hot. Be sure to avoid overheating. A tool which has been burned, or over-heated, on a grinding wheel will not hold an edge. (See Fig. 574.)

Honing or Whetting Tools

Woodworking tools are usually ground to shape on the grinder. But grinding alone is not enough

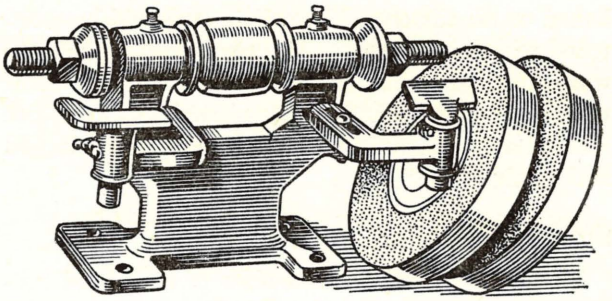


Fig. 568—A grinder head to be run with an electric motor

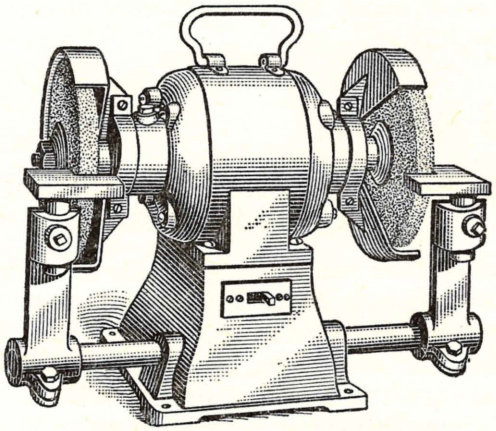


Fig. 569—The electric bench grinder

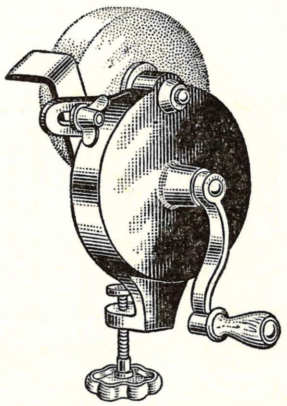


Fig. 570—The hand tool grinder

to produce the keep edge required for woodworking. The grinder leaves a coarse, ragged edge. After the nicks have been ground out, and the edge of the tool has been properly shaped, it should then be

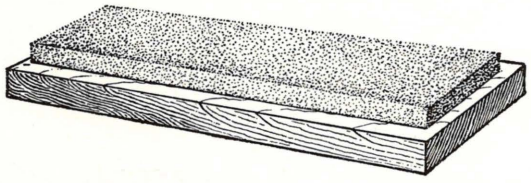


Fig. 571—An oilstone for honing or whetting edge tools

honed on an oilstone. The oilstone should be moistened with machine oil. The purpose of the oil is to wash away the small particles of stone and metal which are worn off. If these particles were not washed away, the stone would soon become clogged and would not cut.

Stropping Tools

Razors are stropped on a piece of leather to produce a keen cutting edge. People commonly strop knives, plane blades, and wood chisels when they have an especially fine piece of work to do. (See Job No. 133.)

JOB NO. 131

HOW TO SHARPEN A PLANE BLADE OR WOOD CHISEL

People often blame the plane blade because it does not cut as they think it should. In most cases, the person who uses the plane is the one who should be blamed for not keeping the blade sharp. It does not take much time to sharpen a plane blade. The improvement in the way it works makes it well worth while.

Here Are the Necessary Materials:

A bench grinder, an oilstone, some oil, and a rag.

Here Is a Plan for Sharpening a Beveled Edge Tool. Follow instructions carefully.

1. Inspect the edge to see what it needs.
   (*a*) Test for squareness with a try square. (See Fig 572.)
   (*b*) Note any nicks or irregular places in the cutting edge.
   (*c*) Note the angle of the bevel.
2. Grind the edge to the proper shape. A good tool rest is necessary to hold the tool at its proper angle against the grinder. The length of the bevel should be about twice the thickness of the blade.

   Caution: It is a good plan to have a can of water handy for cooling the plane blade in case it gets too hot. Dip the blade in the water as soon as it begins to get hot.
3. Hone the beveled side of the blade on an oilstone. The beveled side of the tool should be held flat on the stone. The blade should be moved lengthwise along the stone, using a spiral or figure of 8 motion, toward the cutting edge.
4. Remove the wire edge formed while honing. Lay the straight side of the blade flat on the oilstone. Then move the blade once or twice toward the cutting edge. (See Fig. 576.)
5. Test the edge for sharpness. Wipe off the oil with a cloth, and run the thumb lightly along the edge. If the edge is smooth, yet pulls a little, it is sharp.
6. If an especially keen edge is desired, the edge may be stropped on a piece of leather. The stropping is done on both faces of the blade.

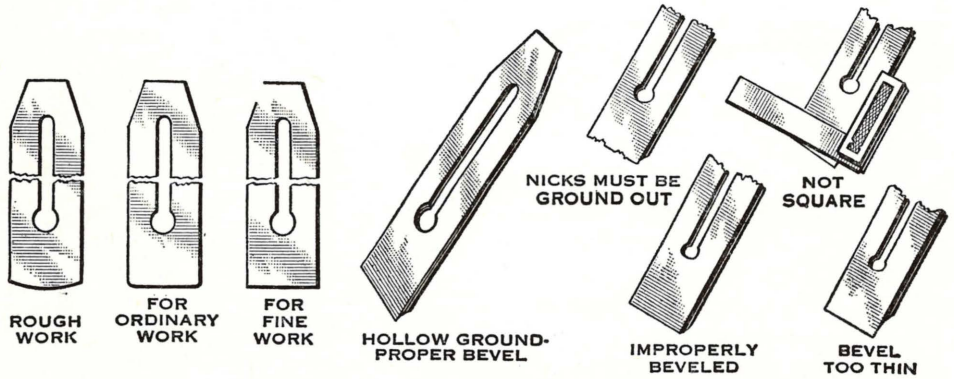


Fig. 572—The plane blade must be ground to the correct shape

Always move the blade away from the cutting edge while stropping.

Is the Finished Job Satisfactory? Answer these questions before deciding how well you have done.

1. Is the bevel uniform and hollow-ground?
2. Is the cutting edge square with the length of the blade?
3. Is the cutting edge sharp?
4. Why is oil used on an oilstone?
5. Why should the blade be kept moving across the face of the wheel while grinding?

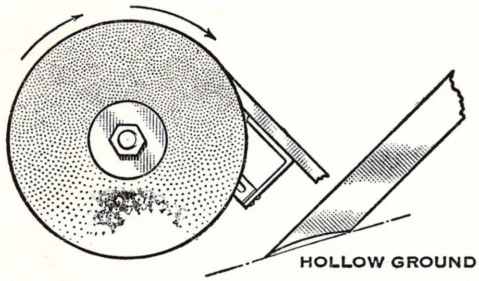


Fig. 573—The bevel of the plane blade is hollow ground on the surface of the grinding wheel. This makes honing easier

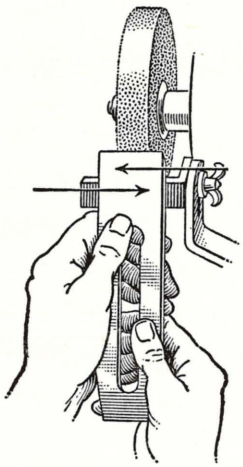
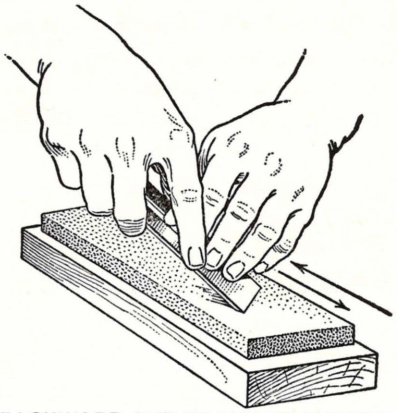


Fig. 574—Move the blade back and fourth across the face of the grinding wheel while grinding



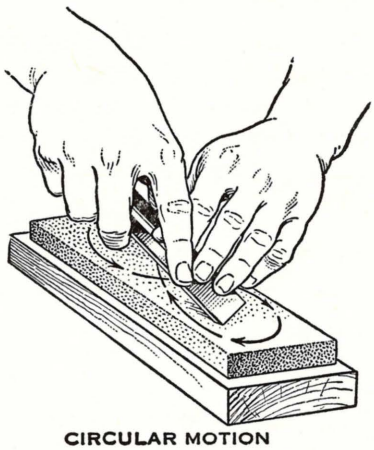


Fig. 575 (*a*) and (*b*)—Sharpening and honing the plane blade

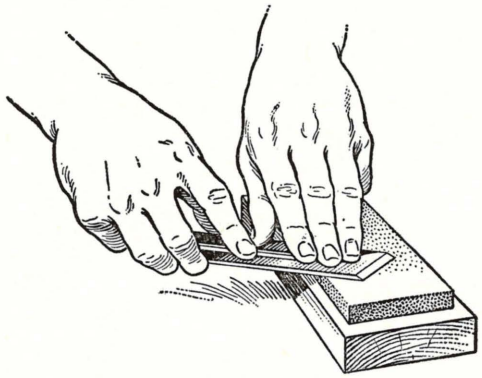


Fig. 576— Remove the wire edge

JOB NO. 132

HOW TO SHARPEN A KNIFE

A sharp knife is a very handy article to have. Yet many people carry a dull knife. Kitchen knives seem to be dull most of the time. A dull knife is more dangerous to use than a sharp one because so much pressure is needed to make a dull knife cut, that it is likely to slip and cause a serious injury. The ordinary person can learn to sharpen a knife if he is willing to follow a few simple instructions very carefully.

Equipment Needed:

A grinder with a very fine-grained wheel is needed if the blade is nicked or otherwise in bad condition.

A grindstone is the best kind of grinding wheel to use for sharpening knives, because the metal in a knife blade is so thin that it burns quickly. An oilstone and oil are needed for putting a keen cutting edge on the blade. A leather strop may be used if a razor-sharp edge is desired.

There Are Many Ways to Sharpen a Knife. Here is a good plan to use if instructions are followed carefully.

1. Inspect the blade to see what it needs. If it is nicked, it needs grinding. If the cutting edge is thick, it must be ground until the blade has a thin wedge shape.
2. Grind the blade. Hold the blade flat on the surface of the wheel. The blade should be held so that the wheel turns toward the cutting edge.

   Caution: Press very lightly on the blade while grinding. Plunge the blade in cold water frequently to prevent it from becoming too warm. The metal in the thin blade burns quickly if too much pressure is used.

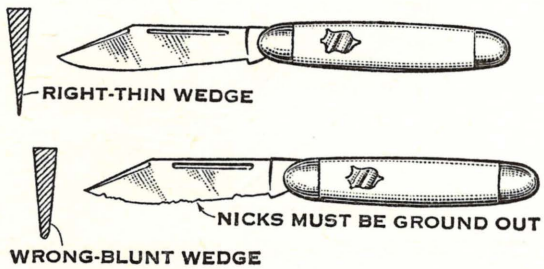


Fig. 577—The knife blade must be ground to a thin wedge and all the nicks removed

3. Hone the blade on an oilstone. Lay the blade flat on the stone and move it over the surface toward the cutting edge. Lift the blade at the end of each stroke; turn it over, and hone the other side on the return stroke.

   Note: Be sure to use oil on the stone for it washes off the small particles of stone and metal, and keeps the stone clean.
4. Test the edge for sharpness. Wipe off the oil with a cloth and test the blade by running the thumb lightly along the edge. If it feels smooth, yet pulls a little, it is sharp. Be sure that it is sharp along its entire length.
5. Strop the edge on the smooth surface of a piece of leather. This is not necessary unless an especially keen edge is desired. In stropping, move the blade over the leather, away from the cutting edge.

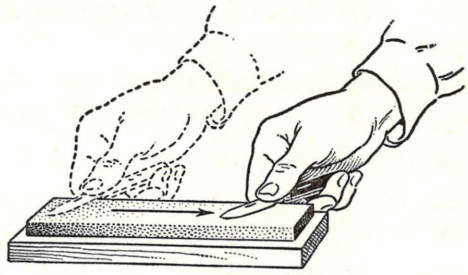


Fig. 578—Hone a knife blade on an oilstone if a keen cutting edge is desired

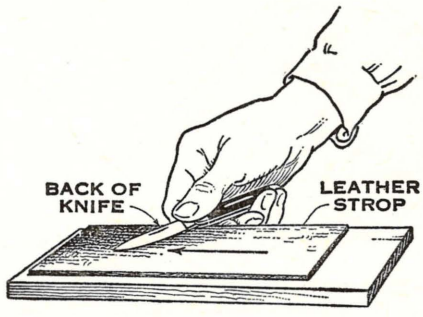


Fig. 579—Strop a knife blade on a piece of leather if a razor sharp edge is desired

Did You Do a Good Job? These questions may help you decide.

1. Does the knife cut well?
2. Are there any dull spots?
3. Are there any nicks in the cutting edge?
4. Is the blade properly shaped?
5. Why will a knife blade burn more quickly while being ground than a wood chisel?

JOB NO. 133

HOW TO SHARPEN AN AXE OR A HATCHET

Trying to cut wood with a dull axe is dangerous as well as difficult. The job will be much easier if the axe is sharp. An axe can easily be sharpened on a grinder or on a grindstone. The improvement in the way it cuts is well worth the time and effort it takes.

You Should Have the Following Equipment

A bench grinder for grinding the edge to shape, and an oilstone for smoothing the edge. A grind-

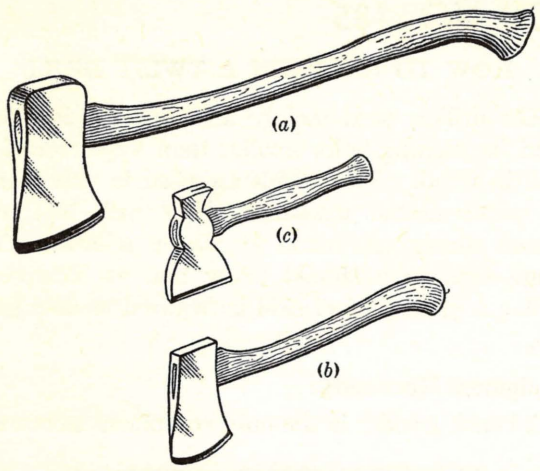


Fig. 580—The regular axe (*a*), the Boy Scout axe (*b*) and the hatchet (*c*) are hand tools

stone is better than the ordinary bench grinder because there is not so much danger of burning the metal in the cutting edge.

Here Are Some Suggestions for Sharpening an Axe or Hatchet.

1. Inspect the edge. Determine the amount of grinding necessary. Are there any nicks which should be ground out? Is the blade thick at the cutting edge?
2. Grind the edge to the proper shape. The tool should be shaped according to the kind of wood it is expected to cut. An axe used for cutting hardwood does not have as slim a taper as one used for cutting soft wood. Cool the edge with water frequently.

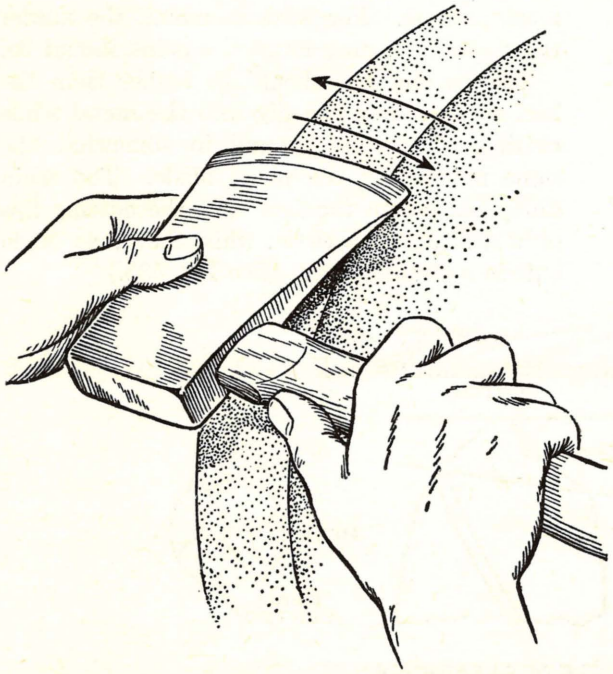


Fig. 581—An axe should be rotated slightly as the cutting edge is moved back and forth across the face of the wheel

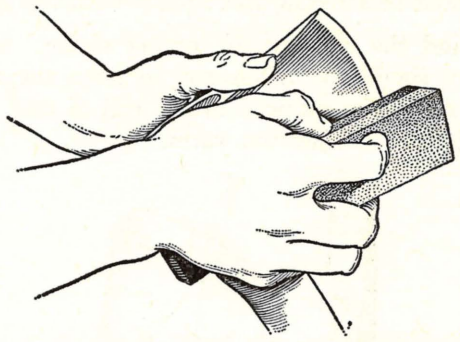


Fig. 582—The axe is honed with an oilstone after being ground to shape

3. Hone the edges with an oilstone. Both the oilstone and the axe are held in the hands. Honing will make the edge smoother and keener.
4. Test for sharpness with the thumb, as for beveled edge tools.

Do You Think You Have Done a Good Job of Sharpening? These questions may help you decide.

1. Is the edge ground to the proper angle and shape?
2. Has the axe been discolored by overheating on the grinder?
3. Is the cutting edge sharp?
4. Does an axe have a beveled or a wedge edge?
5. Should oil be used on the oilstone for honing an axe?

JOB NO. 134

HOW TO SHARPEN A COLD CHISEL

A cold chisel is sharpened with a thicker wedge than other wedge-edged-tools. The thicker wedge makes the cutting edge stronger so that it does not nick so easily. After a cold chisel has been ground two or three times, the edge should be redrawn and hardened by the blacksmith. The home repairman does not usually have the equipment for doing this. It should be done by someone who understands forging and heat treating.

Here Is the Equipment Needed for Sharpening:

A bench grinder is all that is necessary. The cold chisel is not honed.

Here Is a Plan for Grinding the Cold Chisel.

1. Inspect the cutting edge. The angle should be about 35° for ordinary work. For cutting very soft metal, the angle may be less. The edge should be straight and square with the length.
2. Grind the edge to the proper shape. Special care should be taken not to burn the metal. It should be plunged into a can of cold water before it becomes too warm.

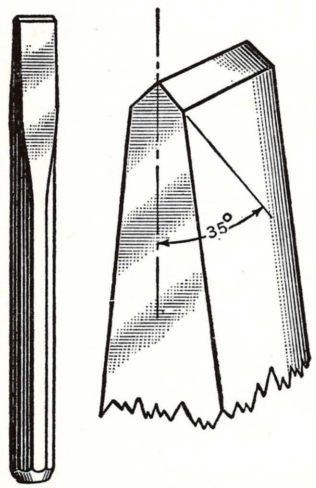


Fig. 583—The cold chisel has a thick wedge for strength

Note: If a corner is broken off, or a deep chip is broken out, it should be taken to the blacksmith and redrawn.

Did You Do a Good Job? See what you think after answering these questions.

1. Has the metal been burned by overheating?
2. Is the bevel about 35°?
3. Is the cutting edge sharp?
4. Why does the wedge for a cold chisel have to be thicker than for a knife?
5. Is it necessary to hone a cold chisel?

JOB NO. 135

HOW TO SHARPEN A TWIST DRILL

The drill is used mainly in metal but it is also used for making holes smaller than a quarter of an inch in wood. Twist drills are used in either hand or motor driven machines, while drill bits with square shanks are made for use in a brace. The home repairman should know how to sharpen a drill. A great deal of skill is required to do a good job.

Equipment Necessary:

A bench grinder is the only equipment necessary.

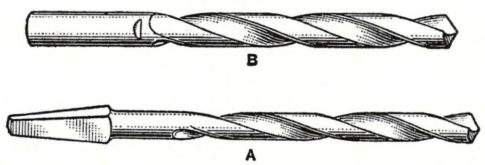


Fig. 584—(*a*) The square shank drill for the brace. (*b*) The round shank drill for the hand drill

Here Is a Plan for Sharpening a Twist Drill.

1. Inspect the point. Is the point dull? Has it been broken or chipped? Is the point in the center?
2. Grind the point to the proper shape. The angle of the point should be 59°. This depends, however, on the kind of work to be done by the drill. For work in wood, the drill may be more pointed. For work in metal, the harder the metal, the more blunt the point should be.

   The cutting lips should be higher than the heel so that they can dig into the metal while cutting. They are ground in somewhat the same manner as the plane blade. The main difference lies in the fact that the cutting lips on a drill cut in a circle, while the plane blade cuts in a straight line. (See Fig. 585.)

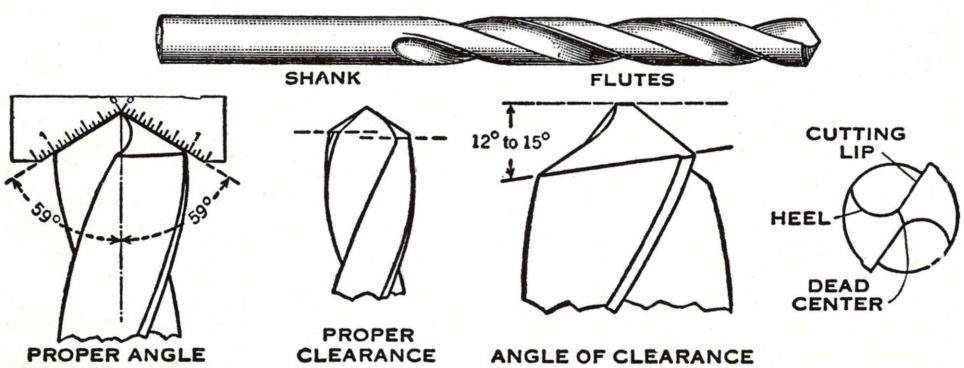


Fig. 585—The twist drill

The lips should both be the same length. Otherwise, the shorter one will have to do all the cutting.

Are You Satisfied With the Finished Job? These questions may help you decide.

1. Is the point ground to the proper angle?
2. Does it have enough lip clearance?
3. Is the point in the center?
4. Does it cut well?
5. What kind of a drill is used in a brace?

JOB NO. 136

HOW TO MAKE A TOASTING FORK

Most people enjoy a picnic where they can toast wieners and marshmallows, but sometimes sticks to toast them on are rather scarce, and even then, sticks are clumsy. A simple home made toasting fork, made from wire, is much better. They are simply and easily made.

Fig. 586—A toasting fork

The Only Material Necessary is a piece of No. 10 wire, about twice the length of the fork desired. If the fork is to be longer than about 30", a heavier wire should be used.

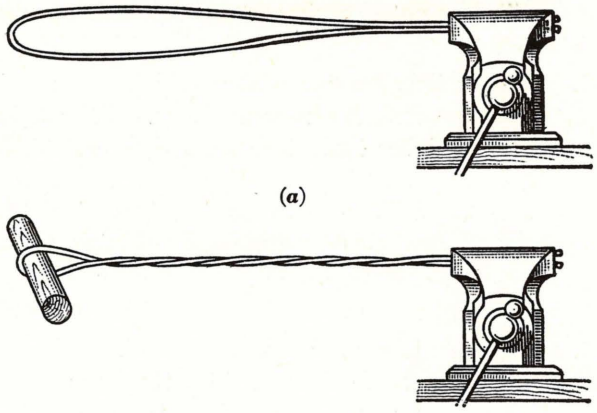
The Tools You Will Need are a pair of pliers, wire cutters, and a stick with which to twist the wire. A file will come in handy to sharpen the tines.

Here Is a Good Plan for Making the Fork.

1. Double the wire and clamp the ends lightly in a vise. (See Fig. 587 (*a*).)
2. Place a round stick in the loop, and twist until the wire is quite stiff. (See Fig. 587 (*b*).)
3. Remove from the vise and shape the fork.
4. Sharpen the tines of the fork with a file.
5. A wooden handle may be added if desired. First, cut the loop off the fork. Then bore a hole in the end of a broomstick and insert the twisted wire.

Have You Done a Good Job? Here are some points to help you decide.

1. Is the handle straight?
2. Is the fork well shaped?



(*a*)

(*b*)

Fig. 587—Forming the wire. (*a*) Wire doubled ready for twisting. (*b*) A smooth even twist can be made

3. Is the wire evenly twisted?
4. What tool should be used to sharpen the tines of the fork?
5. What was used for making the handle?

JOB NO. 137

HOW TO MAKE A NAIL DRILL

When driving screws or nails in wood, a pilot hole should be made first to keep the wood from splitting. For this purpose, a drill made from a small nail is about the most convenient tool. The desired size can be made quickly and easily. It will not break like an ordinary drill, and will cut much faster.

Material Needed:

A nail about one-half the size of the hole desired.

Tools Needed:

A riveting hammer and a file. A vise and an anvil will also come in handy.

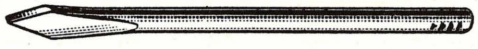


Fig. 588—Drill made from a wire nail

Here Is a Good Plan for Making the Drill.

1. Flatten the point of the nail until it is about twice the width of the shank. Do not pound until it is thin. If a larger hole is desired, use a larger nail.
2. File the edges to a point in the center of the drill. This is the same as the dead center on a regular twist drill. Drills used in wood are pointed, because they are made to cut fast. A pointed

drill does not work in metal, because it cuts too fast.

3. File the lip clearance with a mill file. It is lip clearance that makes a drill cut. The cutting lips are higher than the rest of the point of the drill and meet in the center. As the drill is turned, the lips are always ahead, cutting their way deeper. If the lips were not higher than the rest of the point, they could not cut.

   Caution: Be sure to file the lips the right way.

4. Shape the tang or shank of the drill. If it is to be used in a small hand drill, the head of the nail should be cut off. If it is to be used in a brace, the head should be pounded square with a hammer.
5. Test the drill on a piece of scrap wood. The drill should be slightly smaller than the nail or screw that will be used.

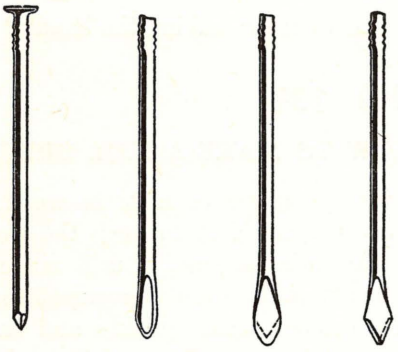


Fig. 589—Shaping the drill from a nail

Are You Satisfied With Your Job? Check it with the following questions:

1. Are the cutting lips higher than the rest of the drill?
2. Is the point of the drill in the center?
3. Does the drill cut well?
4. Why is it important that a drill be centered?
5. How do you select a drill to cut the size hole desired.

JOB NO. 138

HOW TO SHARPEN AND ADJUST SHEARS

When shears become dull they are hard to use, the same as any other dull tool. They are sharpened in a different manner from most tools on account of the difference in their method of cutting. However, the home repairman can keep the household shears in good condition.

The Equipment Needed:

An oilstone is all that is necessary. Both a fine and a medium stone are desirable if a particularly keen edge is desired.

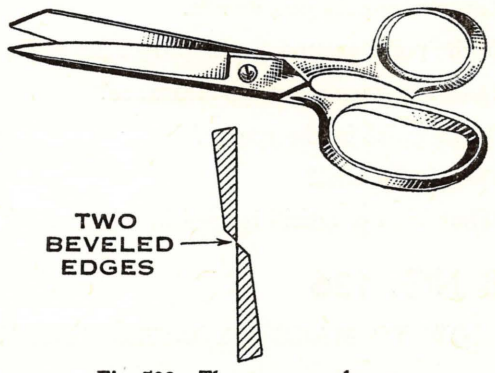


Fig. 590—The common shears

Here Is a Plan for Sharpening a Pair of Household Shears. Be sure to follow instructions carefully.

1. Inspect the mechanism of a pair of shears. Notice that the two blades must come together along their entire length. In order to cut well, both blades must be sharp, straight, and held tightly together.
2. Clamp one blade at a time in a vise and hone with an oilstone. Some people prefer to lay the stone on a table and hold the shears in the hand while honing.

   The stone should be held flat on the cutting bevel of the blade as the stone is moved back and forth.

3. Remove roughness or wire edge from the inside of the blade. Lay the inside of the blade flat on the stone, and draw the stone across once or twice toward the cutting edge.

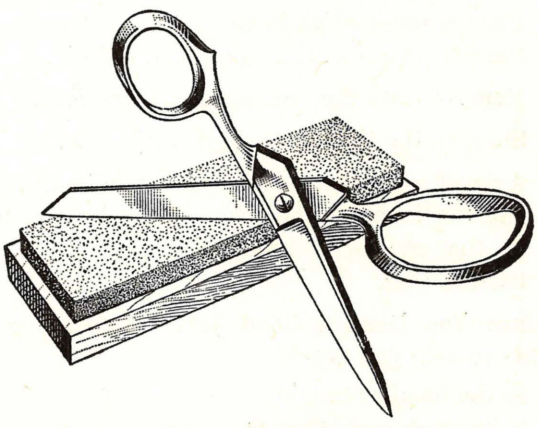


Fig. 591—Shears are honed on an oilstone

4. Sharpen both blades in the same manner.
5. Adjust the blades. The screw holding the blades together may be tightened with a screwdriver. If the blades have been bent or sprung they will not cut well. It is very difficult for one not experienced to straighten them. If they are bent, it is a good plan to take the shears to someone skilled in the repairing of shears.

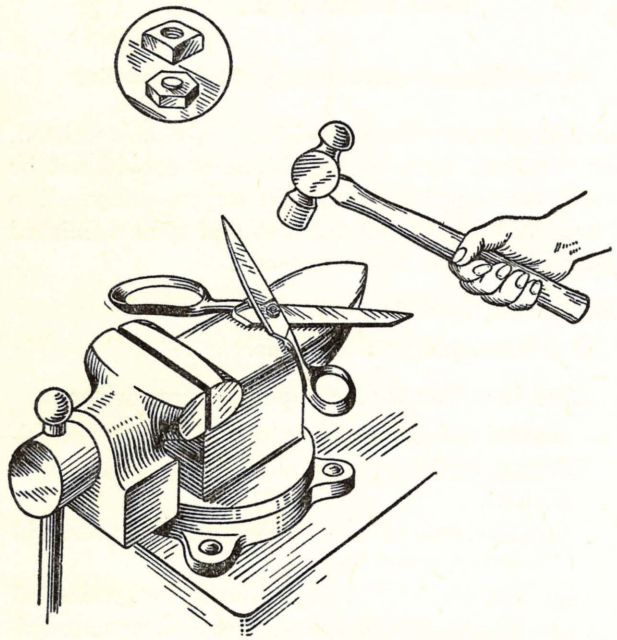


Fig. 592—If there is a nut which does not tighten, place the shears, opened, on an anvil. Place a larger nut on top of the nut, and drive it down with a hammer. Then peen as above

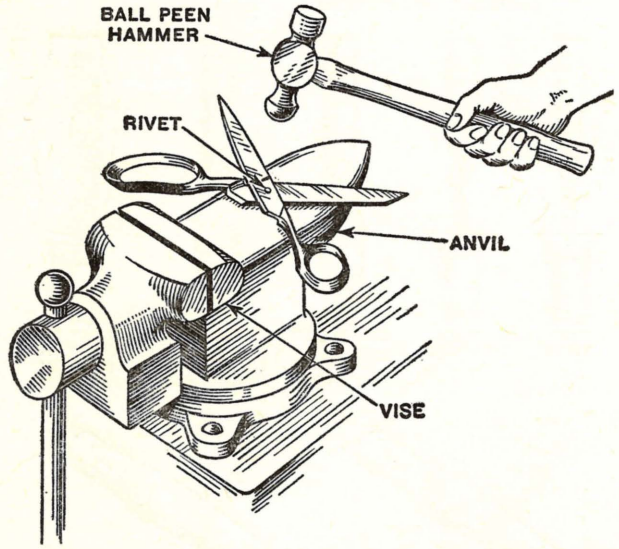


Fig. 593—If there is no nut on the screw, place the shears opened on an anvil and carefully peen the end of the screw with a ball peen hammer

When an attempt is made to tighten the screw which holds the blades together, it will often be found that the screw turns but does not tighten. In this case, there are several things the household mechanic may do.

6. Test for sharpness. Use thin paper or cloth.

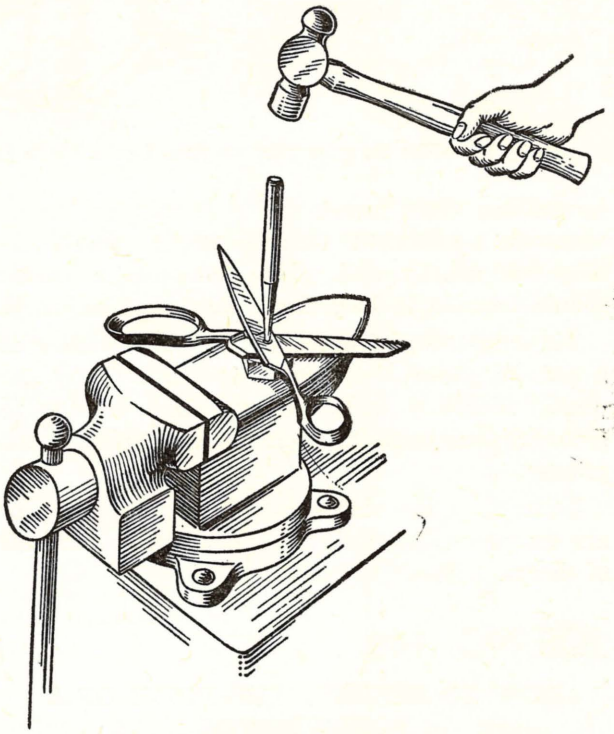


Fig. 594—Drive the old screw out and replace it with a new one. It may be necessary to grind or file the old nut off

Are You Pleased With the Job You Have Done?
These questions may help you make up your mind.

1. Do the shears cut well the full length of the blade? Sometimes dull spots will be found on the blades.
2. Are the cutting edges smooth? No roughness should be felt when the finger is drawn along the blade.
3. Do the blades operate close together, being neither too tight nor too loose?
4. Are shears sharpened to a wedge or a beveled edge?
5. Are shears made of hard or soft steel?

JOB NO. 139

HOW TO SHARPEN A PAIR OF TIN SNIPS

The tin snips is one of the most abused tools in the home workshop. It is used for cutting everything from wire to paper. It should be used only

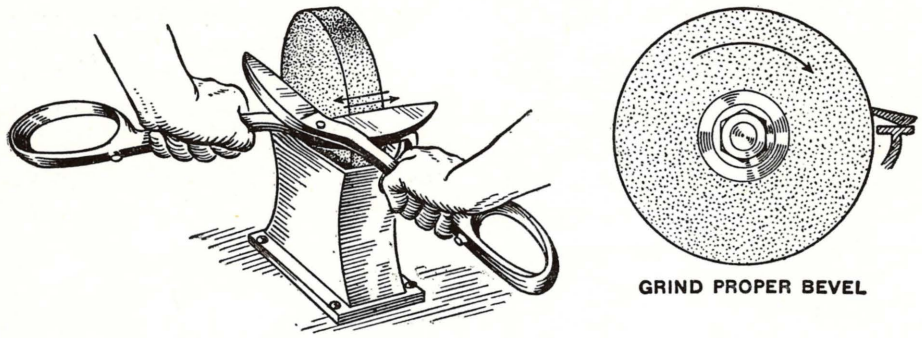


Fig. 595—The tin snips may be ground on a bench grinder. Some people like to take them apart before grinding

for cutting sheet metal, and possibly, fine screen wire. As a result, the tin snips in the home workshop are usually dull. The household mechanic should be able to keep them sharp and adjusted.

Tin snips are sharpened in the same manner as a pair of shears, with one exception. They are usually nicked so badly that the edges have to be ground. This can be done on a regular bench grinder.

Other than the above suggestions, the tin snips are sharpened in exactly the same manner as a pair of shears. (See Job No. 139.)

JOB NO. 140

HOW TO RESHAPE THE POINT OF A SCREWDRIVER

The screwdriver is a most useful tool in the home. This may be the reason that it is so often misused. The screwdriver should never be used as a pry or as a chisel. The blade should fit the slot in the

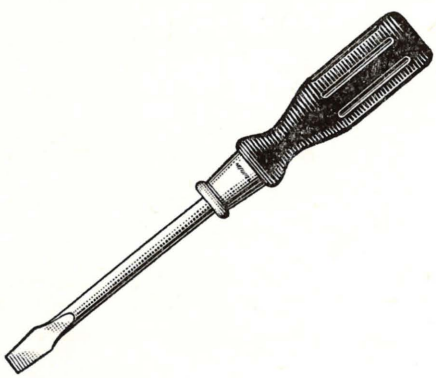


Fig. 596—A screwdriver

screw in which it is used. Three sizes of screwdrivers are needed in the home workshop; one for large size screws, one for medium size screws, and one for small screws. If a small screwdriver is used on a large screw, the end is likely to become twisted. Screwdrivers with damaged blades should not be used, for they will not drive screws safely. The blade may slip out of the slot and spoil a finished piece of work, or injure someone.

Equipment Needed:

A grinder, and possibly a file.

Here Is a Plan for Reshaping a Screwdriver.

1. Inspect the blade of the screwdriver. The following points are the important things to be noticed.
   (*a*) The end of the blade should be straight across, not rounded.
   (*b*) The end of the blade should be ground off square, not sharpened, beveled, or rounded.
   (*c*) The blade should fit the screw. It must fit snugly and squarely, both crosswise and lengthwise.
   (*d*) The blade should be straight. Any twist should be removed.

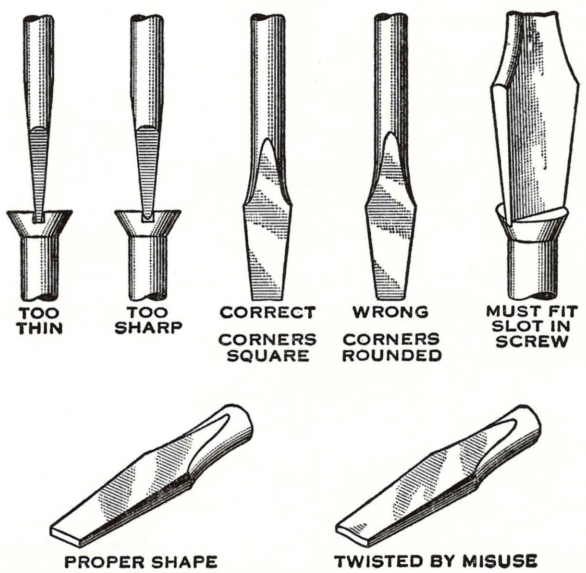


Fig. 597—A properly shaped screwdriver point is important

2. Straighten the blade if necessary. This may be done with a hammer. The screwdriver is made of tough tool steel which does not break easily.
3. Reshape the point on the grinder. Be careful not to burn the metal. It should be dipped in cold water frequently to keep it from becoming too warm.
4. Test the point. Try it in the head of a screw. Does it fit?
5. The point may be hardened if desired. Place the point in the flame of a gas stove or in the coals of the furnace. Be careful not to burn the handle. When the point becomes red hot, draw it out quickly and dip in cold water.

Did You Do a Good Job? Answer the questions before deciding.

1. Are the corners square and the sides flat?
2. Are the sides well shaped?
3. Is the point the correct size for the screws?
4. Should the blade of a screwdriver be sharpened or shaped?
5. Should the blade of a screwdriver be hard or soft?

JOB NO. 141

HOW TO SHARPEN A GARDEN HOE OR SPADE

Hoeing or spading in the garden is not always a pleasant job at its best. When the hoe is dull, it is much worse. As long as the job has to be done the hoe should be kept sharp to make it as easy as possible. This is a very simple sharpening job.

Equipment Needed:

A sharp file is all that is necessary.

Here Is a Plan for Sharpening and Caring for a Hoe.

1. Inspect the cutting edge. The hoe should have a beveled cutting edge. Remove nicks.
2. Clamp the hoe in a vise and sharpen it with a file. The metal in a hoe is soft enough to be cut with a file. The cutting edge should be filed to about a 30° angle for ordinary work.
3. Test for sharpness.

Is the Job Done to Your Satisfaction? Answer these questions before deciding how well you have done.

1. Are there any nicks on the beveled edge?
2. Is the blade clean and free from rust or dirt?
3. Is the blade sharp?

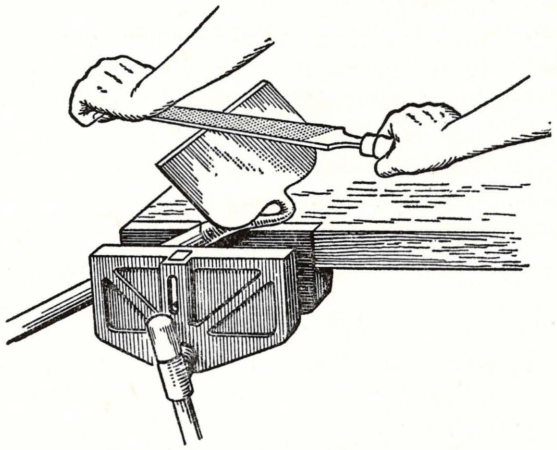


Fig. 598—The garden hoe has a beveled edge. It is sharpened with a file

4. Is the bevel uniform?
5. Is the blade of a hoe or spade made of hard or soft steel?

JOB NO. 142

HOW TO SHARPEN AN AUGER BIT

An auger bit is made of soft steel, and the edge turns over very easily, especially if it happens to strike a nail. The household mechanic should be very careful not to bore into nails, but when it does

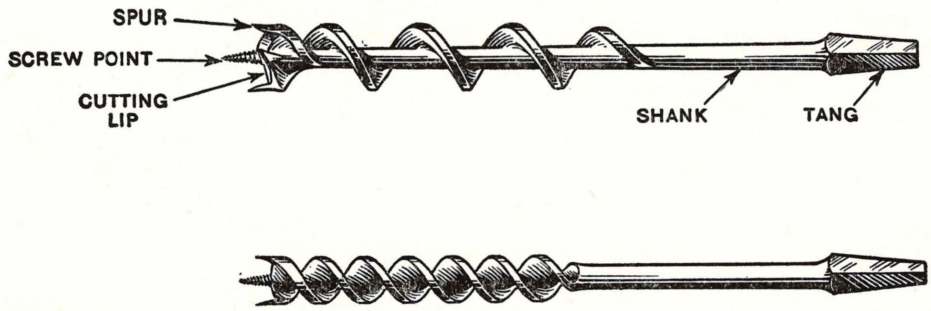


Fig. 599—Both the solid center, and the twist-type auger-bits are commonly found in the home workshop

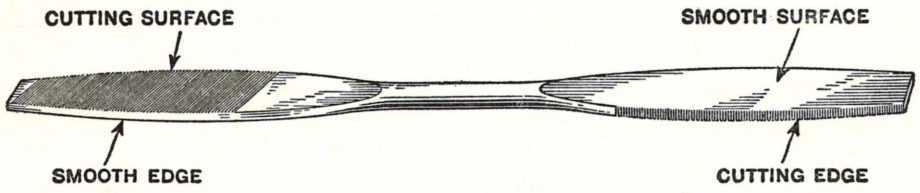


Fig. 600—An auger bit file

happen, he should know how to put the bit back in good condition again. Auger bits also become dull from normal use. They can be sharpened by the household mechanic.

Equipment Needed:

An auger-bit file, and possibly an oilstone will do the job very nicely. An auger-bit file is a special file made for sharpening auger bits. The ordinary file will not be very satisfactory. Observe that on one end, the cutting surfaces of the file are on the sides. On the other end, the cutting surfaces are on the edges.

Here Is a Plan for Sharpening an Auger Bit.

Follow closely, as this is a delicate job.

1. File the spur. Use the end of the file having the cutting surface on the side. Do not file on the outside of the spur. This would cause the spur to outline a smaller hole than it is supposed to. Always file toward the cutting edge. (See Fig. 602.)

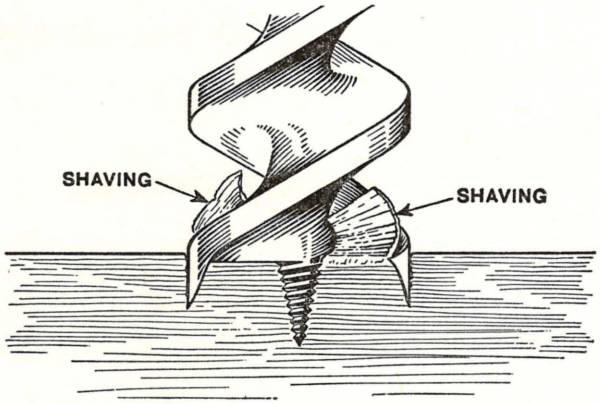


Fig. 601—As the auger bit turns, three things happen. The screw point helps pull the auger bit into the wood, the spurs cut the grain of the wood around the outside of the hole, and the cutting lips plow up the wood from the bottom of the hole

2. File the cutting lips on the upper side. Be sure to use the end of the file having the cutting surface on the side.
3. The end of the file having the cutting surface on the edges may be used to remove the wire edge from the underneath side of the cutting lips. There is not room enough to reach this surface with the side of the file, except on larger auger bits. (See Fig. 603.)

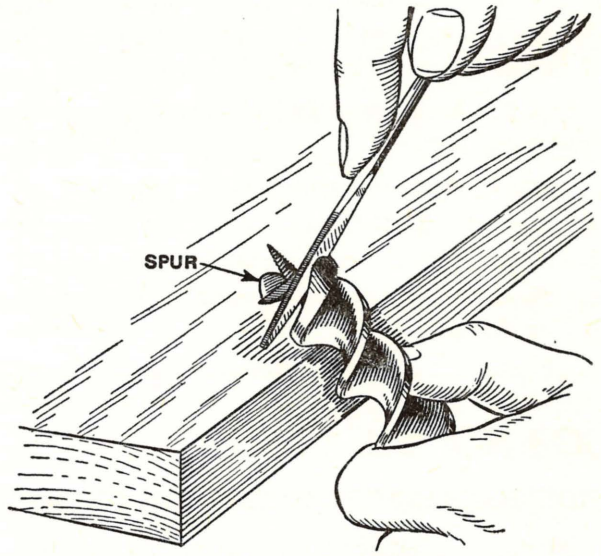


Fig. 602—Hold the auger bit against the edge of a bench and file the inside of the spur

4. Smooth up the outside of the spurs with an oilstone. Do not remove any more metal than necessary to smooth a rough edge.
5. Test the auger bit.

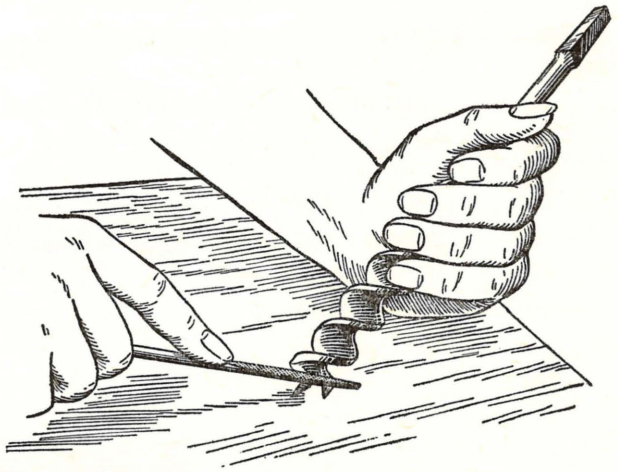


Fig. 603—Place the end of the auger bit on a bench top and file the cutting lips from the top

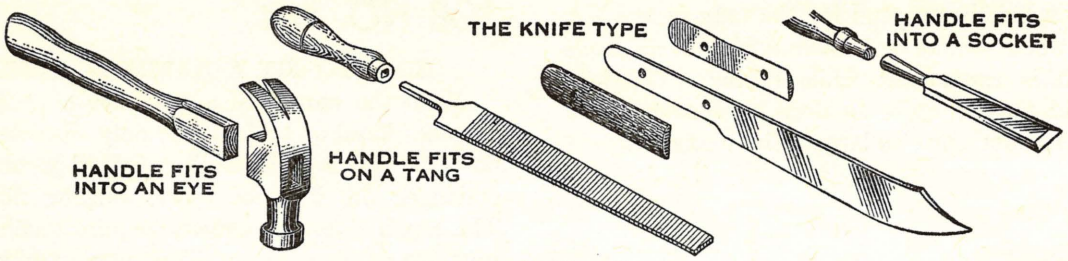


Fig. 604—Tool handles

What Kind of a Mechanic Are You? What Do You Know About the Job?

1. Is an auger bit made of soft or hard steel?
2. Why not grind an auger bit on a grinder?
3. What do the spurs do when boring a hole?
4. What does the screw point do when boring a hole?
5. What do the cutting lips do when boring a hole?

TOOL HANDLES

People often try to use tools with loose or broken handles. It is not only difficult to do good work with a tool in this condition, but dangerous as well. Accidents often occur when the head flies off a hammer or hatchet handle. It may be well to say that a tool which is not worth a good handle should be thrown away as junk.

Here Is Some Worth While Information About Handles.

Hammer handles are made mostly from ash and hickory because these woods are tough, and because the grain is straight. This allows the wood to "give" a little under the strain without breaking. A soft or cross grained wood is not strong enough.

Materials other than wood are used for handles. Electricians desire handles made from some kind of insulating material. Plastic handles have been very satisfactory for this purpose, and more serviceable that wood handles. Some very practical handles have been made out of metal, especially for files and screwdrivers. But for hammers and axes, wood is generally used.

Here Are Some of the Important Types of Handles: (See Fig. 604.)

1. Those which fit an eye, such as the hammer, axe, and hatchet. The hole in the head of the tool is tapered so that when the end of the handle has been spread with a wedge, the head cannot fly off.
2. Those which fit on a tang, such as the file, rake, and hoe. The steel shaft on the tool is driven into the handle, which is bound on the end with a metal ring called a ferrule to keep the handle from splitting.
3. Those which fit into a socket, such as the framing chisel, and cutting tools which are driven with a mallet. These have to be made very strong, and are usually faced with metal or leather to stand the blows of a mallet.
4. Gripping handles, such as those on cranks, planes, saws, and knives. These handles are of many kinds and shapes. It is almost impossible to name all of them. They are often made of materials other than wood; however, cherry and apple wood are generally used.

JOB NO. 143

HOW TO MAKE A FILE HANDLE

The file is not generally thought of as being a dangerous tool. Yet, it is dangerous when used without a handle. Many people have injured themselves by running the tang into their hands. A very good handle may be made with simple tools and materials.

Materials Needed:

If material which is easy to cut is desired, a piece of wood may be split off the side of a block of straight grained white pine. However, an old broom handle is much better, even though it is not easy to cut.

A piece of metal pipe or tubing, $\frac{3}{4}''$ in diameter and $\frac{1}{2}''$ long is needed for the ferrule, which will keep the handle from splitting.

Here Is a Good Plan for Making a File Handle. Follow instructions carefully and make a good one.

1. Round off the corners with a jack knife. Do not cut the handle to shape until later. If a broom handle is used, no whittling is necessary.

2. Drill a hole in one end for the tang of the file. The wood should be held in a vise at an angle which is convenient while boring. The hole should not be quite so deep as the length of the tang nor quite so large as its diameter.

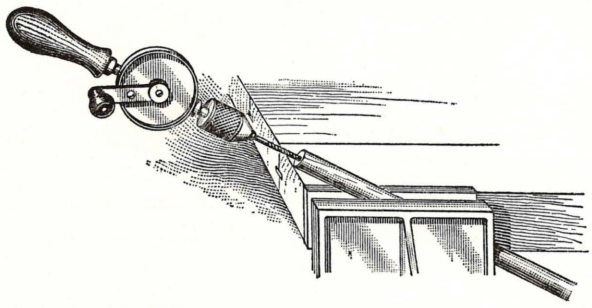


Fig. 605—Drill a pilot hole to receive the tang of the file

3. Shape the handle with a pocket knife. The handle should be shaped to fit the hand. It is a good plan to leave enough stock on the end of the handle so that the pieces may be held easily while shaping. The extra stock is sawed off. The ferrule should fit so tightly that it must be driven into place.

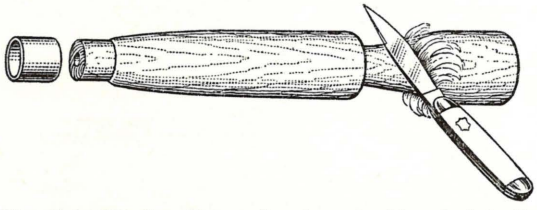


Fig. 606—The handle can be shaped with a jack knife

4. Drive the ferrule onto the handle with a hammer. Be sure it is on tight.
5. Cut off the extra stock and smooth the handle with sandpaper.
6. Paint or stain the handle if desired.

Now That You Have Completed the Handle, What Do You Think of It? See if these questions can be answered favorably.

1. Is the handle well shaped?
2. Does the ferrule fit tightly?
3. What tool is used to make the hole for the tang of the file?
4. Why should you always have a handle on a file?
5. Which direction should you always cut with a knife?

JOB NO. 144

HOW TO FIT A HAMMER HANDLE

When the handle in a hammer, axe, or hatchet becomes loose or broken, the only sensible thing to do is to repair the handle. By all means do not endanger the lives of those working about you. The repair does not usually require much time, at least not as much as an injury would require.

Materials Necessary:

A handle to fit the tool, and some wood or metal wedges. Do not try to make a handle for a hammer. One can be purchased cheap and better than the average person can make. In buying handles, care should be used in selecting one which is well formed and straight grained.

The wedges can be purchased, or they may be made from a piece of strap iron.

Here Is a Plan for Installing a New Handle or Tightening an Old One.

1. Saw off the old handle at the head. Care should be used not to dull the teeth of the saw by sawing too close. A hack saw is sometimes used.

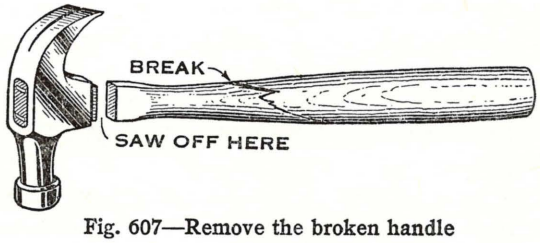


Fig. 607—Remove the broken handle

2. Drive the old wood out of the eye. The head should be placed so that the eye rests over a hole in the bench, or the open jaws of the vise. Place the large end of the hole down. A piece of hard wood or a metal rod, smaller than the eye, may be used as a punch in driving out the old wood. It may be necessary to drill holes through the wood to loosen it.

   Caution: Never burn the wood out by throwing the head into a fire. Heat takes the temper out of the metal.

3. Shape the end of the new handle to fit the small end of the eye in the hammer head. It should fit very tightly. If it fits loosely, too much spreading is necessary and the handle is apt to become loose. A slot should be sawed in the end of the handle to receive the wedges.

4. Drive the handle into the hammer head. It may protrude a half inch or more. This extra length should be sawed off after the wedges are in place.

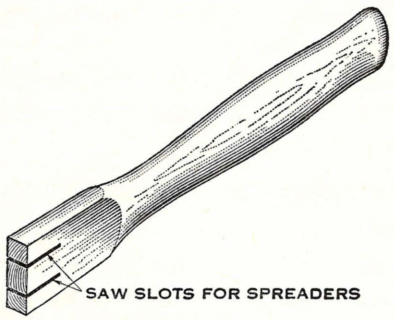


Fig. 608—Handle shaped to fit the eye

5. Spread the end of the handle with wedges. The eye is always larger at the top than at the bottom. This allows room to spread the end of the handle, preventing it from coming off. Drive the wedges with a hammer.

   Caution: Before driving the wedges all the way in see that the hammer head hangs correctly on the handle. It may be necessary to remove the wedges, take out the handle and do a little more fitting.

6. Saw off the end of the handle which comes through the eye. It is best to use a hack saw for this purpose.

7. Put raw linseed oil on the end of the handle. It is a good plan to soak the entire head of the hammer in a solution of raw linseed oil and turpentine for several days. This prevents the wood in the handle from drying out and becoming loose. Be sure to wipe off the surplus oil after soaking.

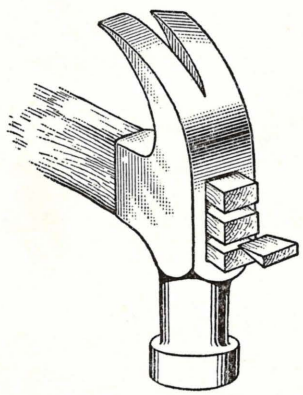


Fig. 609—Wedges spread the handle in the eye

Caution: Be sure to wipe all surplus oil from the metal when it is removed from the solution. If left to dry, it will form a scum on the surface of the metal.

Have You Done a Good Job of Fitting? Ask yourself these questions.

1. Does the handle fill the eye?
2. Is the handle put in straight?
3. Is the handle tight?
4. What kind of wedges were used for spreaders?
5. What tool would you recommend for cutting a broken handle off at the head of a hammer?

JOB NO. 145

HOW TO MAKE A HANDLE FOR A SOCKET CHISEL

Chisel handles often become broken or battered from pounding with a mallet. These may be replaced with new ones purchased from the hardware store, or they may be made in the home work shop.

The Following Materials Are Needed:

Ash or hickory wood is the best. If neither is available, oak or some other hard, tough wood will do. It is well to form the handle on the end of a piece much longer than the length needed in order to serve as a grip while working. Stock at least 1″ square is suggested.

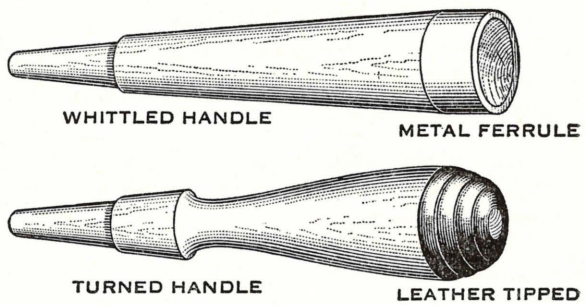


Fig. 610—Handles for socket chisels

A metal ferrule will be necessary to keep the end of the handle from splitting. A $\frac{1}{2}$″ length of 1″ pipe will do very nicely. Some handles are faced with leather instead of having a metal ferrule.

Here Is a Plan for Making a Handle for a Socket Firmer Chisel.

1. Shape the handle with a spoke shave. The socket end should be tapered so that it has the same taper as the socket in the chisel.
2. Saw the handle to the proper length.

3. Shape the end of the handle for a ferrule. Saw around the handle about $\frac{1}{2}$" to $\frac{3}{4}$" from the end to form a shoulder just deep enough for the ferrule to fit tightly over the end when the wood is removed.

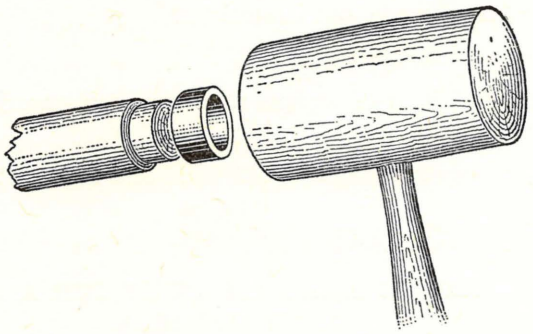


Fig. 611—The ferrule is driven against a shoulder

4. Drive the ferrule in place with a hammer. It must be a "driven fit."
5. Smooth the handle. It is important to make a comfortable grip for the hand. A wood rasp and sandpaper may be used to finish the handle. A file should be used to smooth the metal ferrule.
6. Drive the handle tightly into the socket.

Have You Made a Good Handle? Answer these questions in checking the job.

1. Is the handle well shaped?
2. Does the handle fit the socket?
3. Does the metal ferrule fit tightly on the end of the handle?
4. What is the purpose of the ferrule?
5. Would soaking the handle in linseed oil and turpentine prevent it from drying out and becoming loose?

JOB NO. 146

HOW TO MAKE A HANDLE FOR A KITCHEN KNIFE

Quite often a perfectly good kitchen knife is thrown away because the handle is broken. There are two types of handles commonly found on kitchen knives. There is the tang type, which can be made the same as the file handle. Then there is the two piece type, one end of the blade being riveted between the pieces. This type of handle may be made very easily. Knives may be made from broken hack-saw blades by making handles, and then grinding the blades to the proper shape.

Materials Needed:

Wood, hard rubber, bone, celluloid, or almost any workable material may be used. In order to be brief, this job will deal with the two piece wood handle. Two pieces, slightly larger than the finished handles, are necessary.

Rivets are needed to fasten the handle together. Brass rivets are better than iron rivets, because they do not rust.

Here Is a Plan for Making a Knife Handle. Follow this plan closely.

1. Lay out the pattern on the material for the handle. This may be done by marking around the end of the handle with a knife or sharp pencil. Be sure to mark the rivet holes.

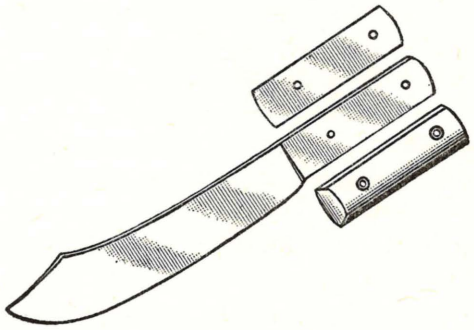


Fig. 612—Handle for a kitchen knife

2. Cut the material roughly to shape. It is not a good plan to finish cutting the material to shape until it is assembled.
3. Rivet both pieces in place. Be sure the rivets are the same diameter as the holes in the knife and in the handles. If the rivet is too long, it will buckle when hammered down.
4. Finish the handle. The handle should now be cut to the size and shape desired. Sandpaper it carefully.
5. Decorate the handle as desired. It may be painted, stained, varnished, or left natural.

Did You Make a Good Looking Handle? These questions may help you decide.

1. Does the handle fit?
2. Was the riveting done neatly?
3. Does the handle feel comfortable when gripped in the hand?
4. What tool should be used to shape the handle?
5. Would a piece of hardwood be better than a piece of softwood for the handle?

JOB NO. 147

HOW TO REINFORCE A HANDLE WITH WIRE

Quite often the handle of some tool is weak, or perhaps a split makes the tool useless. In such a case, wrapping the handle with wire will make it strong enough to use until a new handle can be made.

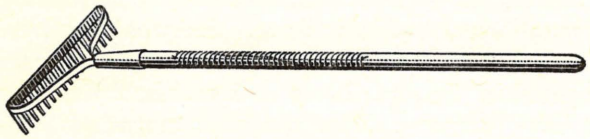


Fig. 613—Long diagonal breaks on the handles of many tools can be strengthened with wire

The Materials Needed: Two small nails or tacks, and enough wire to wrap around the handle about two thirds the length of the break. In case the handle contains a long split, two or three wrappings should be made.

The Tools Needed are a pair of pliers and a hammer.

A Square Break Cannot Be Repaired in This Way Unless Wood or Metal Splints Are Used. Here Is the Way to Repair a Handle That Breaks at an Angle.

1. Clamp the handle in a vise. Leave as much of the break above the jaws of the vise as possible in order to leave room for wrapping. (Fig. 614.)
2. Make a small loop in the end of the wire and fasten it where the wrapping is to start, with a small nail or tack. This is to hold the wire so that it will not slip. Wire cannot be used as easily as cord in whipping a rope, because wire is too stiff.
3. Wrap the wire around the handle. Each turn should be as close to the last one as possible, but never overlapping. The wrapping should go as far as necessary to make the handle strong.
4. Fasten the wire with a nail as at the beginning, and tack fast to the handle. The wire should be cut off after the nail is driven in place to make it tight.

Note: The ends may be soldered.

Did You Do a Good Job? Here are some points to help you appraise it yourself.

1. Are there any ragged edges sticking out which will scratch the hands?
2. Is the handle strong?
3. Is it wrapped neatly?
4. What tool should be used to cut wire?
5. What is done to wire to prevent it from rusting?

JOB NO. 148

HOW TO REMOVE BURRED HEADS FROM TOOLS

The heads of metal tools which are driven with a hammer become mushroomed or burred after a time. The metal which turns down over the end often breaks off when struck with a hammer, and sometimes flies through the air like a bullet. If one of these pieces should strike a person in the eye, it could cause blindness. This safety measure is so simple and easy to carry out that no one should use a tool with a mushroomed head.

Here Is a Plan for Keeping the End of a Cold Chisel or a Punch Safe to Use.

1. Inspect the end which is struck with the hammer. If it is mushroomed, it should be ground smooth on a grinder. If the end becomes too pointed, it should be ground until there is a good flat surface for the hammer to strike.
2. Grind the head to its proper shape.

Are You Sure You Did a Good Job? These questions may help you decide.

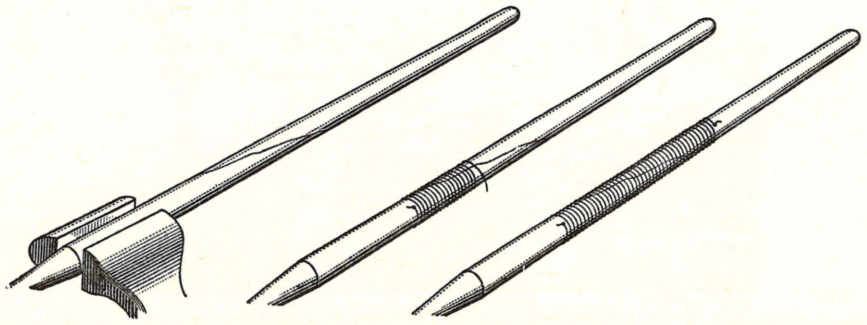


Fig. 614—Wrapping a handle with wire

1. Has the burred or mushroomed edge been removed?
2. Is there a flat surface on the top for the hammer to strike?
3. What is the danger of burred edges?
4. Do handsaws have burred edges?
5. Name two common tools which are apt to have burred edges.

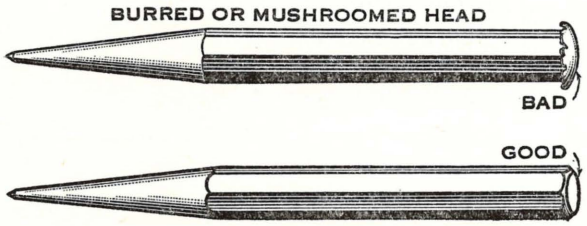


Fig. 615—Burred tools are dangerous

The Specialist

All suggestions given up to this point have been for the household mechanic, or the person who does a little bit of every kind of work. There are many people who specialize in some particular kind of shop work, or hobby, requiring a work shop. For instance, some people like to do art-metal work, such as making bowls, trays, lamps, etc. Some people like to make jewelry. Some like to make pottery, or carve alabaster. Others like to cut and polish semi-precious stones. To list all of the possible hobbies which require a workshop and tools, would take much time and study.

Each hobby requires tools and equipment which are particularly suited to the kind of work to be done. The more specialized the hobby, the more specialized the tools and equipment must be. No attempt will be made here to list the many different highly-specialized hobbies, or to suggest equipment for them. If a person is interested in doing some particular kind of work, there are several things he can, and should do, before buying a lot of equipment.

First, learn as much about the hobby as possible through every possible source. See what the local library has on the subject. Talk to others who are engaged in the same hobby. A real hobbyist likes to have company. Find out what magazines publish articles on the line in which you are interested.

Second, observe others who are doing the same kind of work. If possible, try your hand at it. The hobbyist who will not help others to learn is selfish, and not a true hobbyist at heart. People who live in or near large cities can often find evening courses in their chosen line.

Third, invest as small an amount of money as possible in tools and equipment necessary to do the work. It is not a good plan to invest much money until you find out whether you are really interested, or it is just a passing fancy. It might be well to say at this time, do not buy cheap, or poor quality equipment. The beginner needs just as good tools as the master craftsman.

Fourth, if you find that you are really interested, your tools and equipment will keep pace with your enthusiasm. As you progress, take advantage of as many contacts as possible among others who are interested in the same thing. Improve your skill and knowledge in whatever way possible. Many people have turned hobbies into profitable vocations.

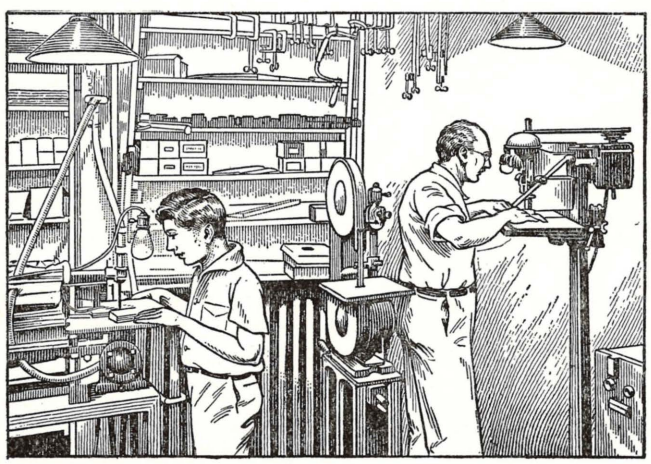


Fig. 616—A workshop in the basement is a splendid form of entertainment for both young and old

Fig. 617—Manufacturers of home workshop machinery publish very good literature on the use of their products

POWER MACHINERY FOR THE HOME WORKSHOP

As stated before in this chapter, people are often oversold on home workshop tools and equipment. This is particularly true of machinery. People who have had no experience or training in tool operations, often get the idea that machinery is all they need to turn out beautiful work. This is far from being true. The sloppy workman with hand tools is usually a sloppy workman with power machinery. A machine will do an operation perfectly if the operator has the skill and knowledge necessary to operate it properly. But a machine does not think.

Who Should Use Power Machinery

There is no certain age or sex which should use power driven home workshop machinery. School boys turn out beautiful work on the scroll saw and lathe. Women and men alike have wonderful success with all kinds of home workshop machinery. The household mechanic is apt to find, after having had experience with hand tools, that he needs a table saw or lathe. As a matter of fact, anyone who is willing to learn, or anyone who already knows how to operate power driven home workshop machinery can profit from its use.

Learning to Operate Power Machinery

Anyone who is skilled in the use of hand tools has the advantage in learning to operate power machinery. He has learned to do many of the operations by hand, that he is now learning to do by machinery.

Manufacturers of home workshop machinery are very anxious that people learn to operate their machinery properly. They have learned that a satisfied customer is good advertising. When the customer fails to do good work he is not satisfied, and is poor advertising. Therefore, many of these manufacturers will send literature, free or for a very small charge, telling how to operate their machinery. The beginner will do well to take advantage of this form of instruction in addition to any other help he may have.

People who live in or near a city usually have an opportunity to learn how to operate power machinery through courses offered in the public schools. Small towns often have well-equipped shops where courses are offered.

Anyone who is interested enough to buy home workshop equipment should buy or subscribe to one or more good hobby magazines. They always have articles which are of help to the craftsman. Public libraries usually have good books on the operation of home workshop machinery. Then, there are always friends who are willing to give help and advice. People who have the same hobby interests usually get along well together. Anyone can learn who has the proper frame of mind, and who is willing to apply himself. The best advice however, is to start slowly. Do something easy first. The more difficult jobs can come later.

Outfitting a Shop With Power Machinery

One plan for outfitting the home workshop with power tools is to buy an entire outfit at one time. An entire outfit may be anything from three or four pieces, to a dozen or more, depending on the needs of the craftsman. This plan may be satisfactory for the craftsman who is familiar with power machinery, but it is questionable for the beginner. There is too much for the beginner to learn all at one time. He is apt to become discouraged and abandon the entire thing; whereas, if he buys one or

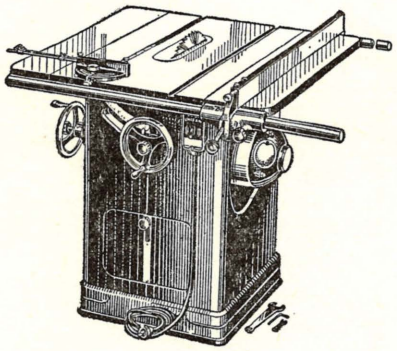


Fig. 618—The table saw should have plenty of room

two pieces and learns to operate them before getting more, the chances of keeping up his interest are much better. People do not remain interested very long in anything they cannot do with reasonable success. Another objection to this plan is that the cost is higher than most craftsmen can afford at one time.

Another plan is to buy one or two pieces at a time. One man bought a table saw so that he could make screens for his house. He saved enough money on the screens to pay for the saw. More equipment may be added as needed, or as the money is available.

In buying home workshop machinery, people naturally want to get as much as possible for their money. But in so doing, they are apt to get inferior machinery. This is not good economy. If a 12-inch scroll saw is large enough for the purpose intended, it is foolish to buy the 24-inch size. But be sure to get a good 12-inch size. Examine several makes of machinery before buying. Here are some important points to consider.

1. Is the design of the machine good. Is it handy to operate? What special features does it have?
2. Is the machine well made? Castings should be heavy. Is it good and solid?
3. What kind of bearings does it have? Ball bearings are usually thought to be the best. What about places for oiling?
4. Is the machinery made by a reputable firm which is apt to be in business when replacement parts are needed?
5. Do you know anyone else who has one of the same make or size?

Machinery Suitable for the Home Workshop

When a home workshop is being developed, machinery should be purchased or made to do the operations intended. It is impossible to say just what machinery is needed without first knowing what kind of a shop it is, and what kind of work is to be done in it. One person may want to do general woodworking, another will be interested in metal work. The next best thing is to list the more common machines used in home workshops, and tell briefly what each will do.

The Table Saw

The table saw is used wherever straight cutting is to be done. It is excellent for ripping boards to width, and for cutting miters. It may also be used for crosscutting. There are two main types. On one type the table tilts, making it possible to saw at an angle. On the other type, called the tilting blade, or tilting arbor, the table remains stationary while the blade may be tilted at an angle.

Unless the shop is large and the saw can be set in the middle of the room, the saw should be set on a stand which can be moved around. The reason for this is, that long boards will be ripped on the saw, so twice the length of the boards is needed. The next piece to be cut may be a crosscutting operation, and extra room will be needed in the other direction. If the saw can be moved conveniently, much less room will be needed.

The Jointer

The jointer is a very useful piece of machinery in a home workshop. It does a lot of the heavy work. It is used to plane the edges of boards, either square to the face, or at an angle. The fence is adjustable for this purpose. The jointer is not very satisfactory for planing the faces of boards unless they are narrow. It is a problem of holding the stock rather than of the ability of the machine to do the work.

The same advice is given regarding the jointer as for a number of other machines. Do not get one which is too small. A 4-inch jointer is satisfactory if only light work is to be done. But

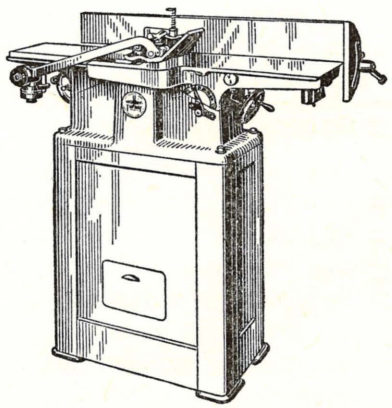


Fig. 619—The jointer is used for planing the edge of boards

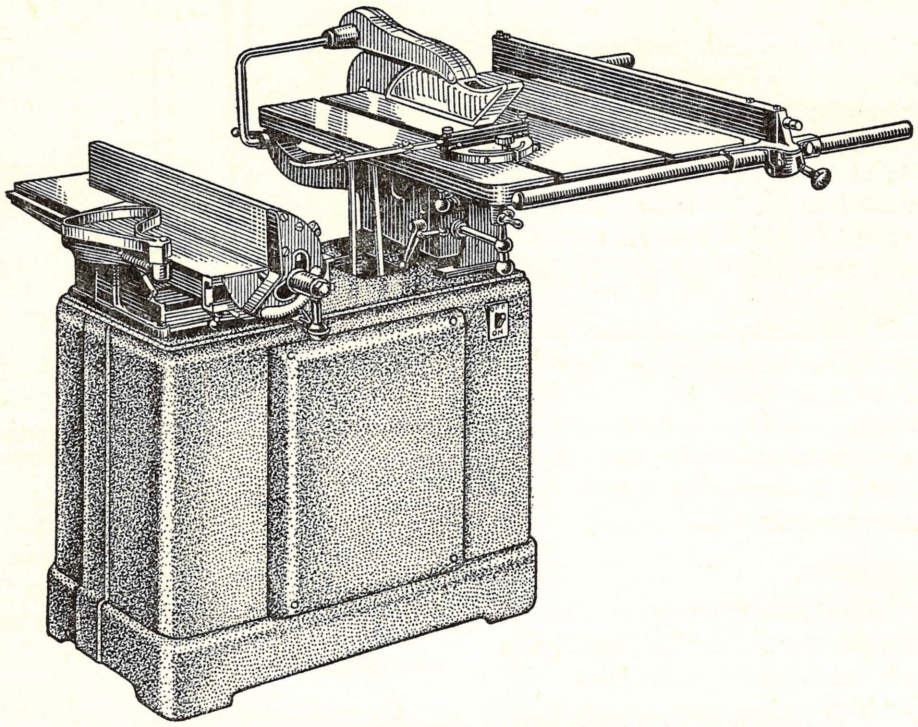


Fig. 620—The table saw and jointer combination is a handy arrangement

craftsmen need a 6-inch jointer. This size is large enough to take care of almost any job the home craftsman might be called upon to do.

The Table Saw and Jointer Combination

The table saw and jointer are often mounted on the same stand and operated by the same motor. The two machines are often used at the same time, and having them mounted together saves space and makes a handy arrangement. It also cuts the cost because only one motor is needed for the two.

The Scroll Saw

The scroll saw, often called a jig saw, is probably the most popular home work shop machine. It is made in a number of sizes, from the small vibrating models up to the 24-inch size. The scroll saw is used for cutting curves of all kinds.

The scroll saw should be mounted at a height which is convenient, and in a location where there is plenty of room. It is necessary to have plenty of room in order to be able to turn large projects while sawing.

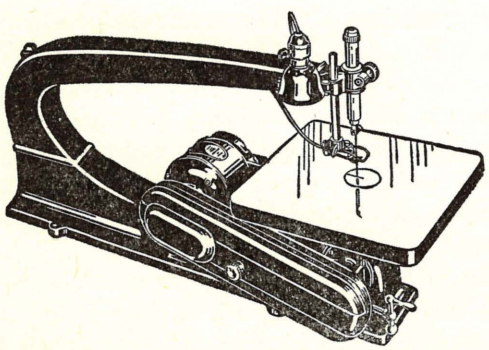


Fig. 621—Scroll saws are made in a number of sizes

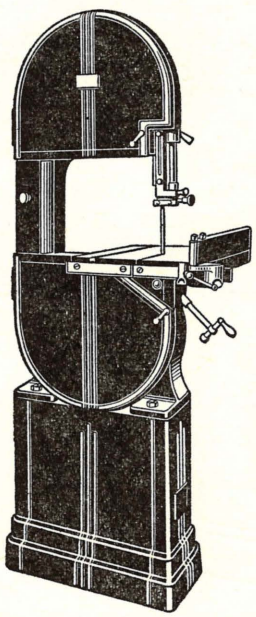


Fig. 622—The band saw is used for ripping or cutting curves

The Band Saw

The band saw is a very popular machine. It is used for sawing straight lines or curves. It is somewhat limited in its ability to saw curves, because it will not cut the inside of a circle without cutting through the circle at some point. As a crosscut, it is limited to short lengths. It is the opinion of the author that except for thick wood, a scroll saw and table saw will serve the needs of the home workshop much better.

Another point to consider is the tendency of the home workman to overwork a band saw. A 12-inch band saw will cut 3″ or 4″ wood if the wood is fed to the saw very slowly. The home workman is apt to force the saw, however, and before long the saw is out of adjustment. If heavy work is to be done, a larger saw should be purchased.

The Wood-Turning Lathe

It seems to be the ambition of every craftsman to have a lathe in his home workshop. This is probably because operations can be done on a lathe which cannot be done by hand, while other machines, for the most part, do the same operations, but do them easier. The craftsman can turn out many beautiful articles on a lathe.

There are many sizes of wood lathes, from the very small, almost toy models, up to the professional size. As is true with most home workshop machinery, there is a tendency to buy the small sizes in order to save money. The price of a lathe is low compared with other home workshop machinery. As large a size as possible should be purchased. The larger sizes are more stable, more accurate, and larger work may be done on them. The bed of the lathe should be long enough that a full-size table leg can be turned. The head should run on ball bearings. The swing, or the distance from the live center to the bed, should be great enough to accomodate turnings of reasonable size.

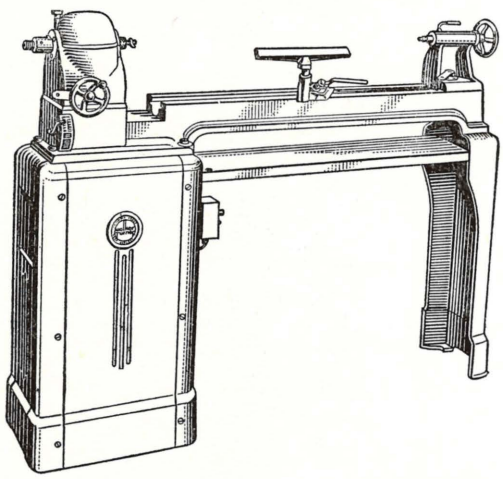


Fig. 623—The lathe is a prized possession of most home craftsmen

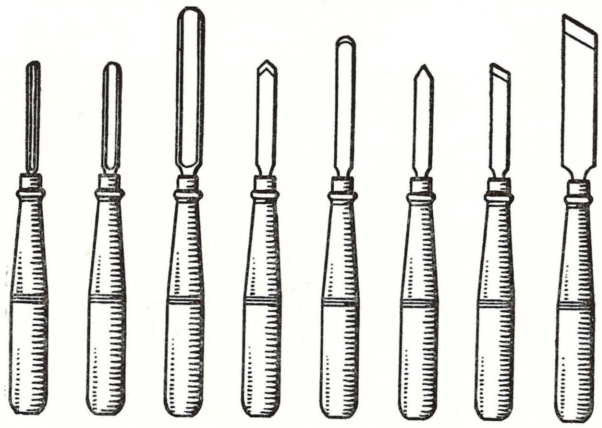


Fig. 624—A good set of wood turning tools is the pride of a craftsman who does wood turning

Wood-Turning Tools

The craftsman who buys a lathe must also have a set of wood turning tools in order to do all of the operations. He will do well to buy a good set. Wood turning tools must be kept sharp and well oiled. They usually come in a case, and should be kept in the case when not in use. Eight tools compose the ordinary set of wood turning tools.

The Metal-Turning Lathe

The turning of metal objects in the home workshop has become very popular during recent years because of several reasons. First, it is possible to make many attractive articles of turned metal. Second, the use of metal has become more important in industry, and in our every-day lives. Third, the lathe in the home workshop is often a means of training for a job. Fourth, many people have earned extra money at home by making small parts for factories.

A great amount of skill and knowledge is required to operate a metal-turning lathe. Skilled lathe hands, who can do all of the operations on a lathe, are much in demand in industry. The home craftsman will do well to proceed very slowly unless he has had training in the operation of the lathe. Advantage should be taken of all instructional aids possible.

There is possibly a greater range of sizes and models in metal-turning lathes, than in any other home workshop machinery. A small bench lathe is usually satisfactory for the home workshop. The

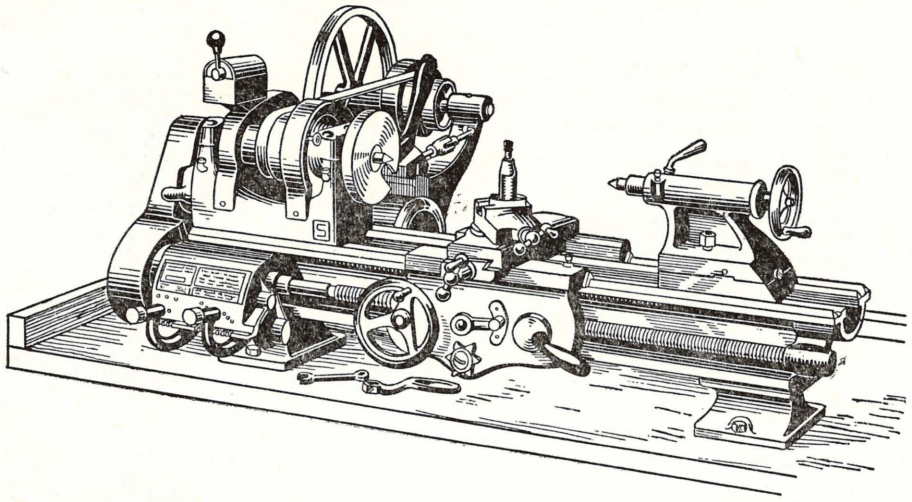


Fig. 625—A small metal turning bench lathe is ideal for the home workshop

home craftsman should beware of cheap models, because a lathe has to be well built to be accurate, and accuracy is very necessary in turning metal. The cost of a metal-turning lathe is usually greater than the cost of any other piece of home workshop machinery.

The Shaper

The advanced craftsman will want a shaper in his home workshop to cut fancy beads, curves, etc., around the edges of table tops and moldings. The beginner can get along very nicely for a while without one. Many craftsmen never do buy one for the home workshop. Instead, they buy a high speed drill press and use it as a shaper. (See page 232.)

The Drill Press

The drill press is one of the popular machines for the home workshop. It can be used for all drilling and boring operations. The speed can be adjusted to vary from about 400, to about 5000 revolutions per minute.

A shaper attachment is often used on a high speed drill press, thus saving the cost of an extra machine. (See page 232.)

The Planer

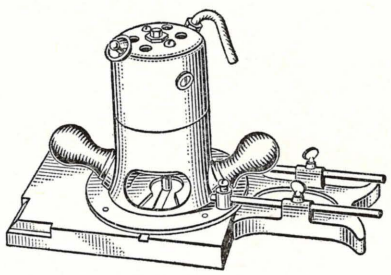
The planer is a machine which is not often seen in a home workshop. This is probably because it costs too much money to get one large enough to be of much use to the home craftsmen. The largest machine known to the author at the present time, made for the home workshop, will take stock up to 12 inches wide. One which will take wider stock would have to be a full-size professional machine, and would be too large for the home workshop. (See page 232.)

Power Sanders

Eventually, most home workshops are equipped with some form of power sander. Those illustrated below are only suggestive of the many possible varieties of power sanders. (See pages 233-234.)

Power Grinders

No workshop is complete without some type of grinder. The craftsman who buys power machinery should certainly have some form of power grinder. (See Tool Sharpening, page 208.)



Machine Router

Like the hand router, this machine is used principally for cutting grooves and dadoes. It is manufactured with a motor-in-head which drives the cutter in shaper fashion at very high speed. It is guided by two handles and may be set for varying depths of cuts. Cutters are obtainable in different widths and shapes.

Power Buffers

A power driven buffer is somewhat like a power driven grinder. The main difference is that the shaft is usually longer to allow more working space around the wheel. The buffer is usually driven with a **V**-belt attached to a motor. Buffing wheels are usually of felt or cloth, and can be purchased in many forms to suit the needs of the metal worker. It is very necessary for the craftsman who has art metal or jewelry for a hobby. (See page 234.)

Power for the Home Workshop

A very small amount of home workshop machinery is made with the motor built into the frame of the machine. Most of it is made so that a motor may be attached. In this present day and age, it is assumed that electric power is available almost everywhere. But there are still many workshops which do not have electric power available. To meet the needs of all situations, pulleys are installed on practically all home workshop machinery in such a position that any source of power may be used. A gasoline engine may be used if necessary.

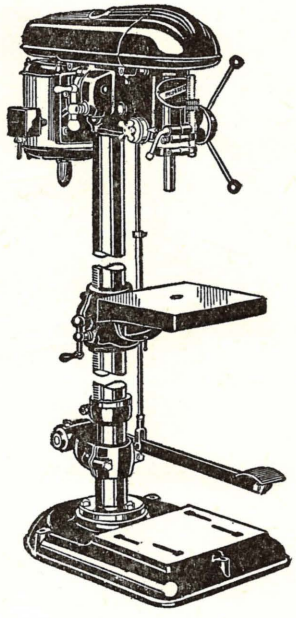


Fig. 627—The bench type of high-speed drill press for the home workshop

Be Sure to Have Enough Power

The source of power must be strong enough to run the machine at full speed under its maximum

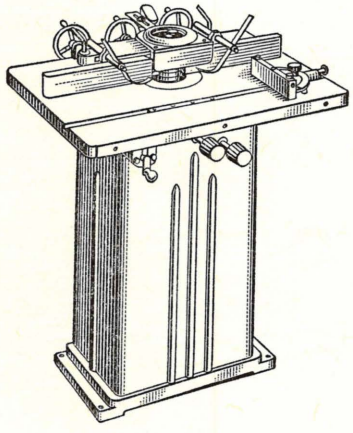


Fig. 626—The shaper is used for cutting fancy edges and moldings

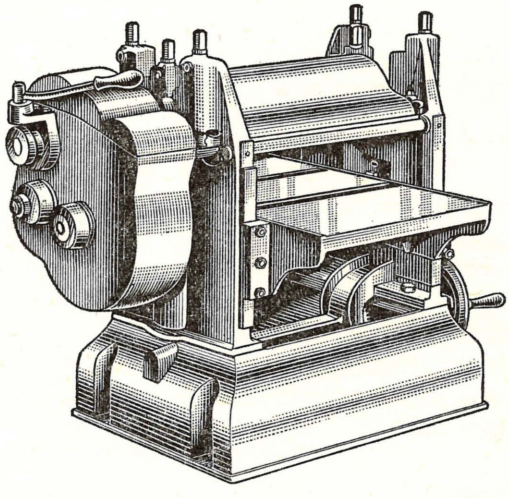


Fig. 628—The home workshop planer will take stock up to 4 inches by 12 inches

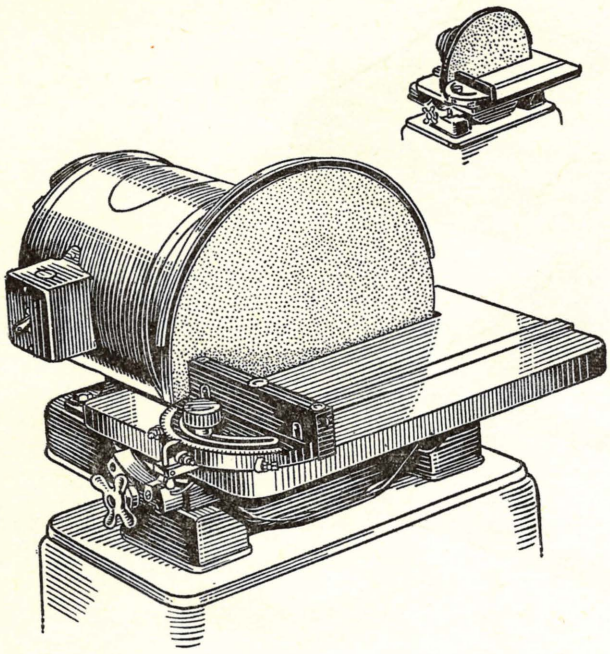


Fig. 629—The disc sander may be driven directly by a motor, or have a belt drive. Its use should be limited to end grain and curved edges

load. When buying a machine, always find out the amount of power necessary. Attempting to operate a machine without enough power is not satisfactory. Not only is it wasteful from the standpoint of time and labor, but it overloads the motor. A motor which is regularly overloaded does not last long. If a machine needs a one-half horse power motor, the source of power should develop at least that much. It is better to have too much than too little.

The Speed Is Important

Some machines are operated at higher speeds than others. The shaper, for instance, is operated at a speed of about 8500 revolutions per minute (R.P.M.). The scroll saw should be operated at a maximum speed of not over 1750 R.P.M. There are two methods of getting the speeds required.

An ordinary electric motor will develop a speed of between 1425, and 1750 R.P.M. A high speed motor will develop a speed of between 2850, and 3450 R.P.M. Be sure to find out what R.P.M. is required to operate any piece of home workshop machinery which does not have the motor built into the frame. A shaper or a jointer operated at a speed which is too slow would not do good work.

The second method of determining the speed at which a machine is operated, is by means of pulleys of different size. A large pulley on the motor and a small one on the machine will cause the machine to turn faster than the motor. Also, a small pulley on the motor and a large one on the machine will cause the machine to run slower than the motor. So it is very important to know the size pulleys to have on both the motor and the machine. Any standard make of home workshop machinery has this information listed. If the source of power is other than an electric motor, the R.P.M. must be

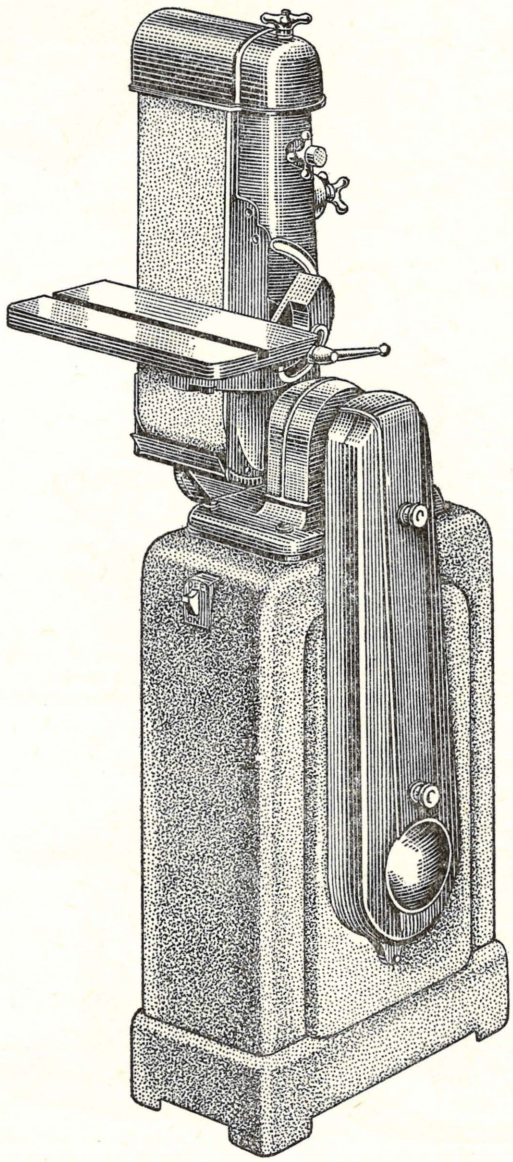


Fig. 630—The belt sander may be used for sanding straight surfaces or ends and edges

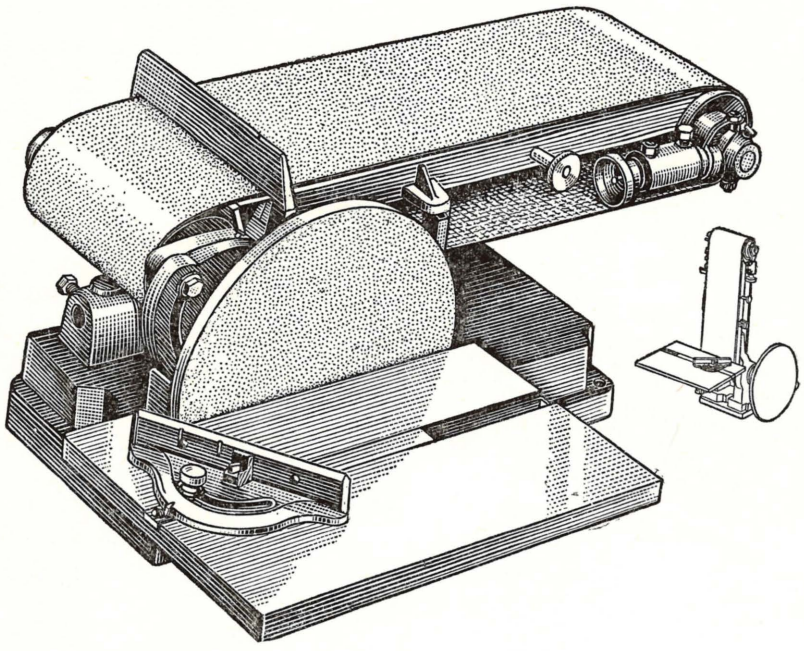


Fig. 631—A combined belt and disc sander makes a very practical machine

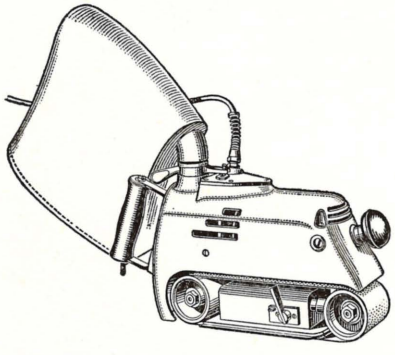


Fig. 632—The portable sander is more expensive than other forms of sanders, but it is a very useful piece of machinery for floors, bench tops, table tops, etc. The ordinary home craftsman, however, may not have enough use for one to make it worth while to own one

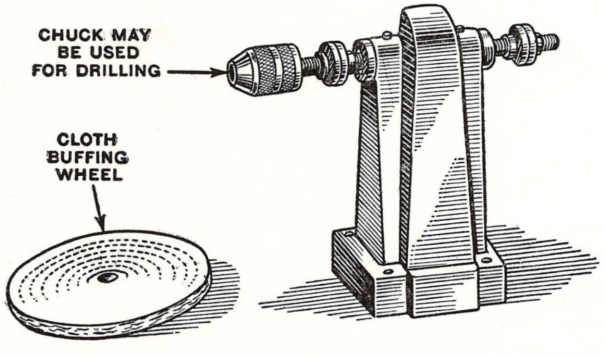


Fig. 633—The buffer is usually driven with a V-belt attached to a motor

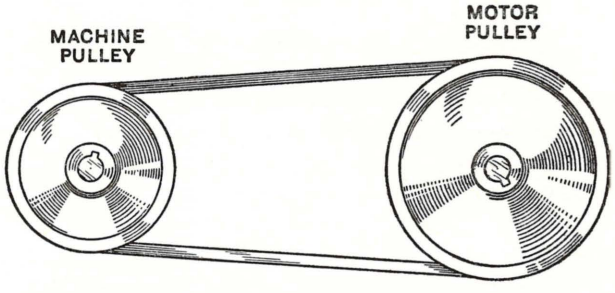


Fig. 634—This arrangement would cause the machine to run faster than the motor

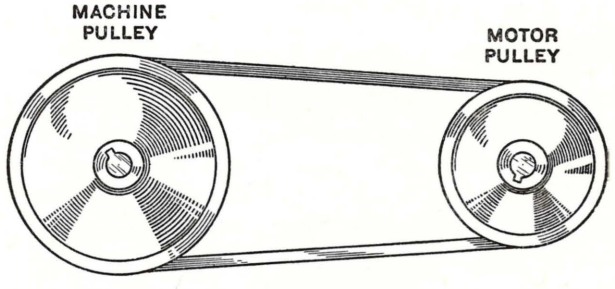


Fig. 635—This arrangement would cause the machine to run slower than the motor

determined, and the proper pulleys installed. The person who is not experienced in figuring such things will probably have to get the help of an expert. The table in Fig. 636 will be of value.

HANDY TABLE OF PULLEY SPEEDS

Use this table to determine the speed of your machine with varying sizes of motor and machine pulleys. Figures given are for use with belt at proper tension and a motor speed of 1750 R.P.M.

Diameter of Motor or Driving Pulley	Diameter in Inches of Driven Pulley or Pulley on Machines						
	1½	2	2½	3	4	5	6½
1½ in.	1725	1290	1030	860	645	520	400
2 in.	2300	1725	1380	1150	860	690	530
2½ in.	2890	2160	1725	1440	1080	860	660
3 in.	3450	2590	2070	1725	1290	1030	800
4 in.	4600	3450	2760	2300	1725	1380	1070
5 in.	5750	4310	3450	2870	2160	1725	1330
6½ in.	7460	5600	4490	3740	2800	2240	1725

Example—The machine has a 2-inch pulley and should run 3450 or 3500 R.P.M. What size pulley should be used with a 1750 R.P.M. motor? From the table follow down the vertical 2-inch column to the speed of 3450, then to the left in column headed "Diameter of Motor or Driving Pulley." The answer is a 4-inch diameter pulley required.

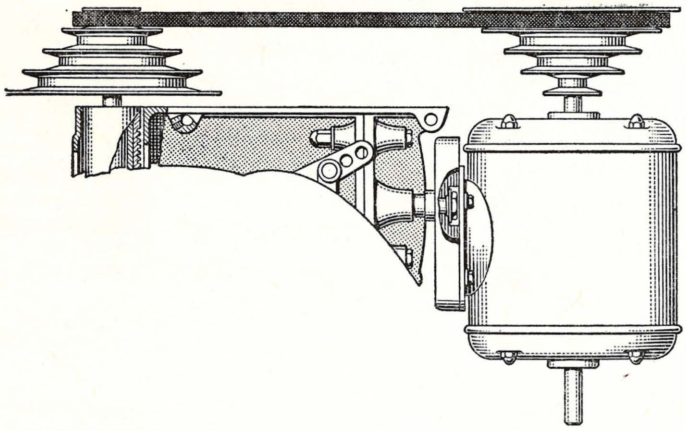


Fig. 636—Many home workshop machines have two, three, four, or five step pulleys so that they may be run at different speeds. This belt is put on so that the machine will run faster than the motor

How Many Motors Are Needed In a Workshop

If the home craftsman buys a separate motor for each machine he will soon have a lot of money invested in motors alone. Most people would prefer to save a little on motors, and have a little more to spend for more machinery. There are several ways in which he can economize.

First, he can buy machinery, which can be paired together and run off the same motor. For instance, there is the table saw, and jointer combination. (See page 229.) Then, there is the drill press and shaper combination. These two combinations would save two motors, and without sacrificing any convenience.

Second, there are a number of patented motor mountings on the market which permit the motor

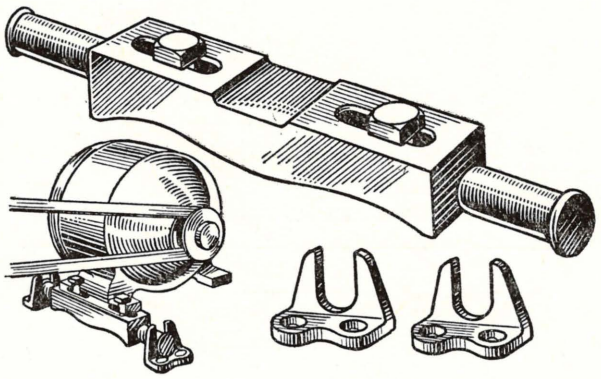


Fig. 637—This type of motor mounting permits the motor to be moved quickly from one machine to the other

to be moved from one machine to the other without the removal of any screws or bolts. In this way one motor will serve for a number of machines, as long as the horsepower and speed of the motor is high enough. This kind of mounting also has another good feature. It keeps the belt tight at all times without any adjusting.

The third method is by means of a line shaft. A motor, or even a gasoline engine large enough to operate the heaviest machine is mounted on or underneath the bench, and a belt is run up to the line shaft. All machines are mounted on the bench, and each has a pulley on the line shaft. Belts are removed when the machines are not in use. In the home workshop, usually not more than one machine is in operation at a time. This arrangement would give plenty of power at all times, and would be a great saving in the cost of motors.

The Arrangement of Machinery In the Home Workshop

Giving advice on the arrangement of machinery in the home workshop is very difficult, because there is no definite sized space to use in planning, and there is no definite number of machines. Each craftsman has his own problem. However, a few sample plans might give the beginner enough ideas to work out his own problem to good advantage.

This plan should be of help to the craftsman with only a few machines, or with very little space.

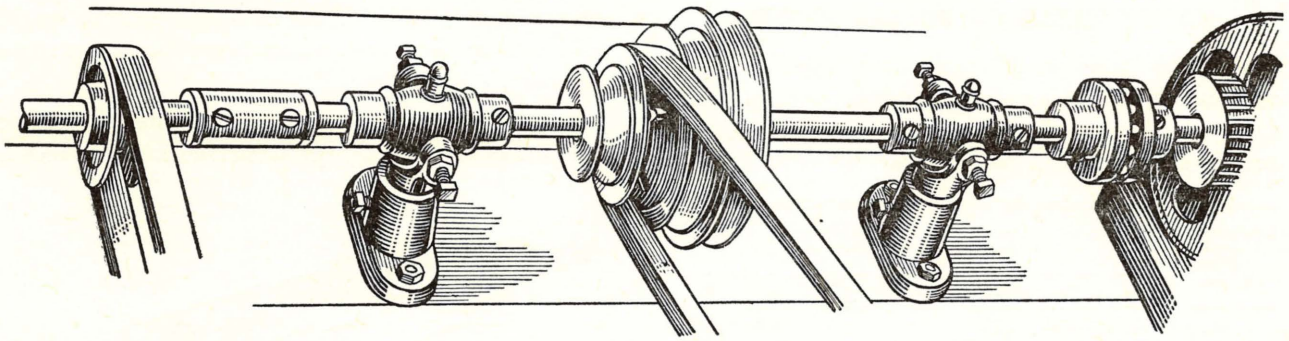


Fig. 638—The line shaft permits a number of machines to be run with one motor

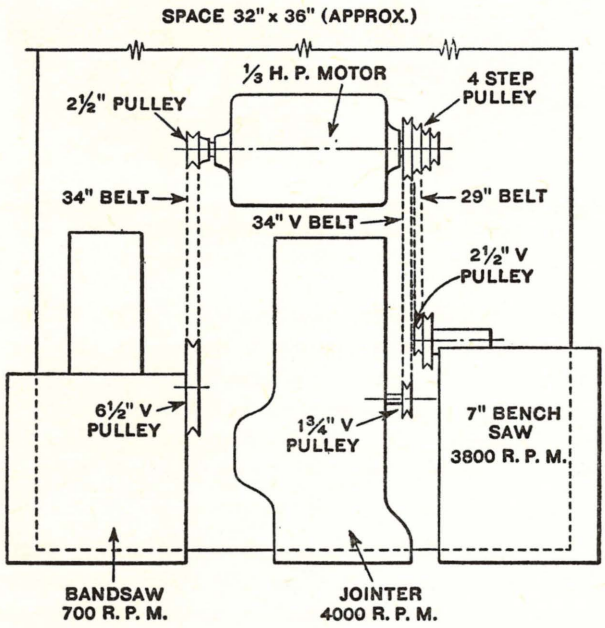


Fig. 639—Layout for motor, bandsaw, jointer and circular saw

The entire outfit can be mounted on a bench top 32″×36″.

Other recommended plans for a home workshop are shown on pages 237-238. The workshop in Fig. 640 has grown in the way of equipment. This outfit requires a bench top 42″ x 48″. This arrangement can be used effectively in a small workshop.

In writing this chapter, the authors have been fully aware that they have not solved all home workshop problems. This is impossible. Again, may we repeat: Find out what someone else has done, and use what you can of his ideas. Your situation will probably be different, but the experience of others should help you. Solving your own problems will make the home workshop all the more interesting. The man who solved his home workshop problem as shown in Fig. 550 was very happy over his success. Since his problem is a common one, his solution is passed on to you.

A Summary on Safety for Household Mechanics

Perhaps you have observed that, throughout the book, *safety* has been stressed wherever activities or jobs may be dangerous or lead to injury. Safe ways of doing things may take longer than short-cuts, but they cause fewer accidents. Regardless of how careful we are, accidents do occur in and about the home. A few safety precautions to keep in mind to reduce accidents are:

1. Put all rags containing oil or paint in a metal container.
2. Store inflammable liquids in metal cabinets.
3. Discard tools with burred edges, broken handles, or loose heads, or repair them before using.
4. Always wear goggles when operating a grinder.
5. Do not stand in line with moving parts of a machine being operated by another.
6. Do not talk to a person operating a machine.
7. Be sure to disconnect all electrical appliances such as heaters, glue pots, sanders, etc. when leaving the shop.
8. Do not use electrical cords or electrical appliances not in good condition.
9. No matter how trivial you may consider a cut, to be on the safe side, sterilize the wound.

Sterilization of wounds implies that every home workshop should be equipped with a First Aid Kit.

Types of First Aid Kits

First Aid Kits are of two general types: (1) the unit-type kit and (2) the kit in which there is no uniformity as to size or type of packages. In the unit type of kit, each dressing is complete in itself and is sealed in wax paper. It contains just sufficient material for treating a single injury, thereby eliminating waste. All liquids are put up in individual sealed glass containers, thus preventing deterioration.

The original cost of a unit kit may be slightly higher than that of a general kit, but, where materials are handled by many different persons, this type is more satisfactory in the long run.

The advantage of a general kit, in which there is no uniformity of size, is that the contents may be varied to meet the needs of the purchaser. The contents of the general kit should be arranged so that the desired package can be found quickly without unpacking the entire contents.

Contents of a Home Workshop Kit

The following items should be included in your First Aid Kit: Band aids; iodine, mercurochrome, or other antiseptic; cotton; adhesive tape; rolls of 1″ and 2″ bandages; small scissors; safety pins; burn ointment; and wooden applicators.

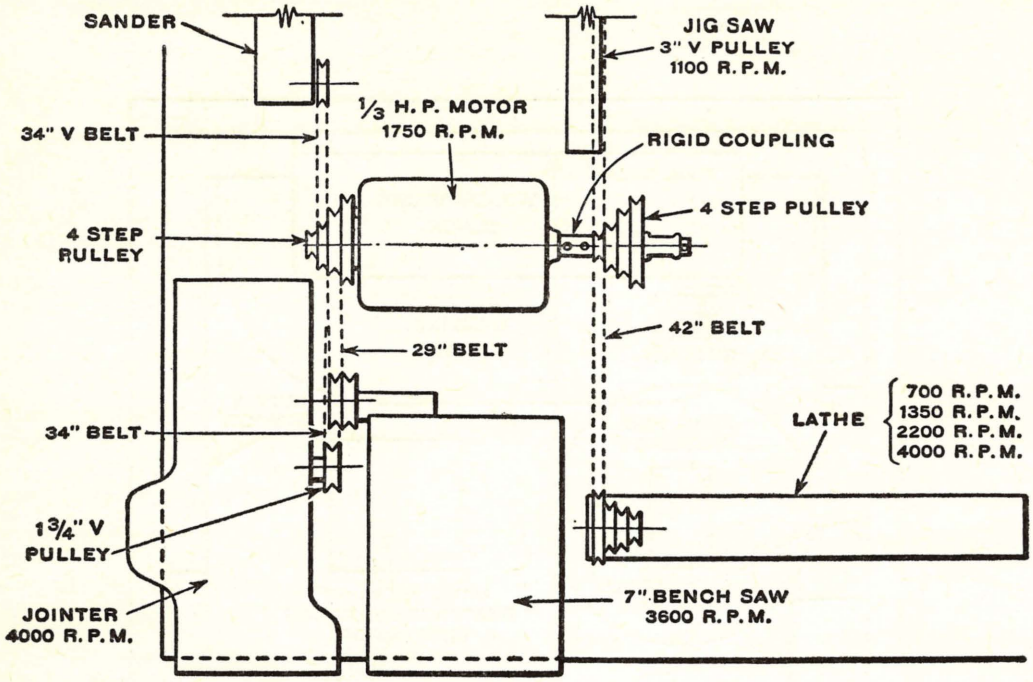


Fig. 640—The workshop

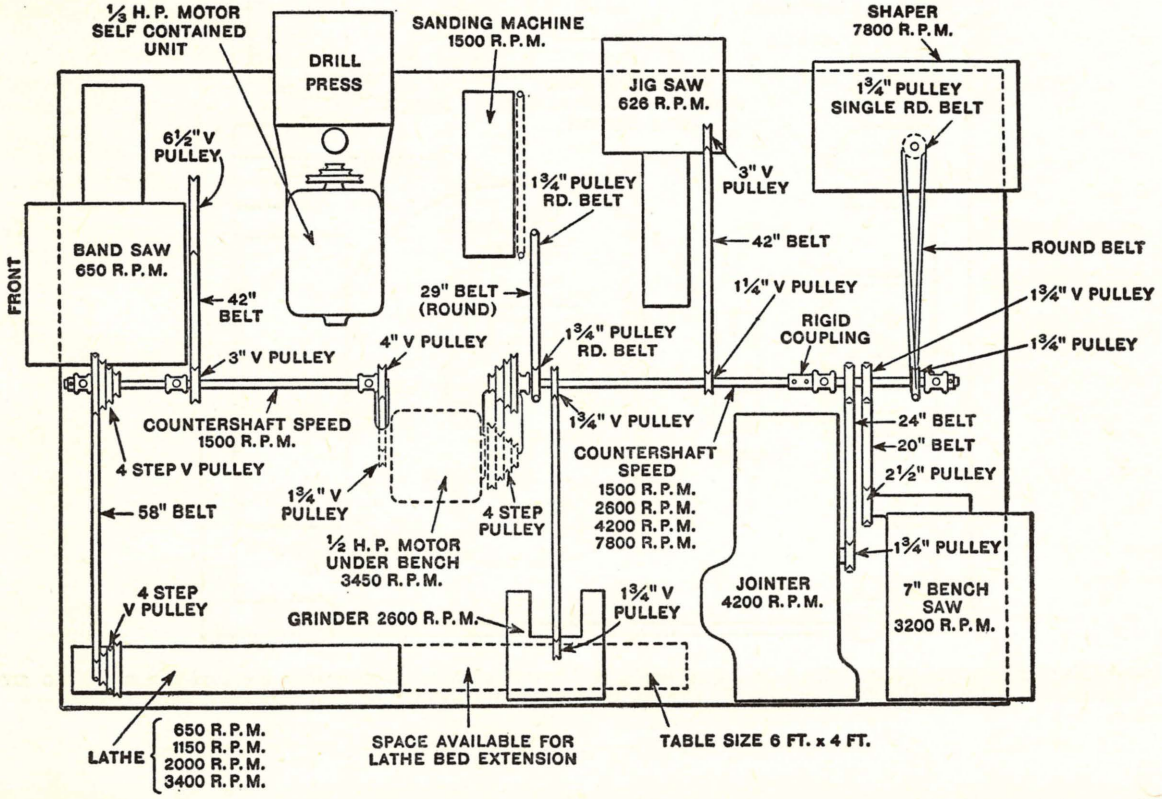


Fig. 641—An outfit like this would please many master craftsmen. Two motors will run the entire outfit of nine machines

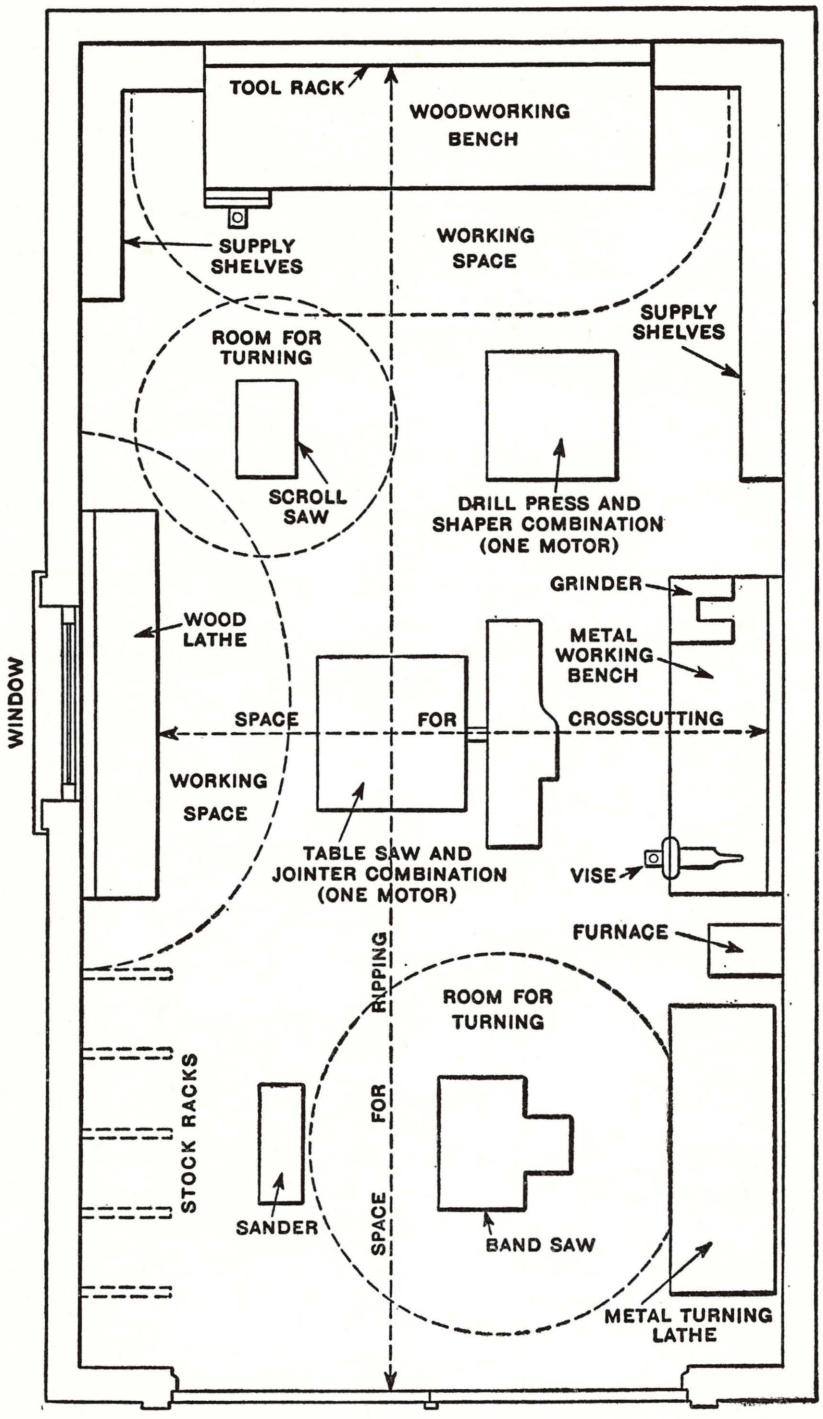


Fig. 642—This plan assumes a space about the size of half of a two-car garage. Notice that most of the machines are mounted on individual stands, and may be run by interchangeable motors, or each may have its own motor

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